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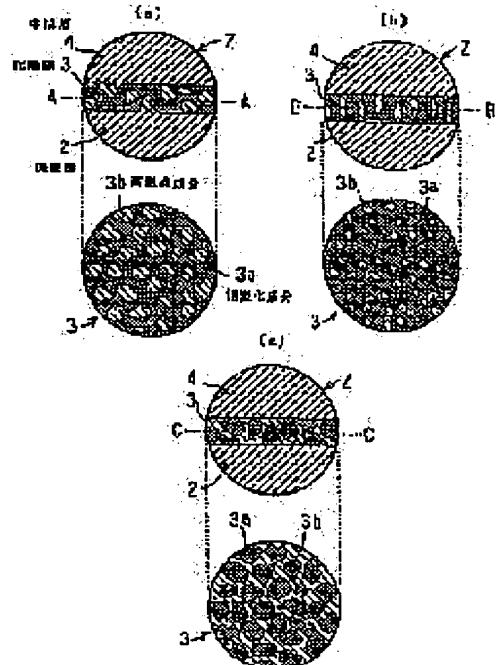
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(54) DATA RECORDING MEMBRANE AND MEDIUM

(57)Abstract:

PURPOSE: To enable many-time rewriting, and super-resolving reading while keeping high recording/reproducing characteristics.
 CONSTITUTION: Cr and at least one element X selected from Ag, Ba, Co, Ni, Pt, Si, Sr, Au, Cd, Cu, Li, Mo, Mn, Zn, Al, Fe, Pb, Na, Cs, Ga, Pd, Bi, Sn, Ti, V, In and a lanthanide element or B are added to an Sb-Te-Ge or Sb-Te-In base phase change type recording membrane 3 or super-resolving reading membrane. A component 3b having an m.p. higher than that of the phase change component 3a is precipitated in the recording membrane 3 or super-resolving reading membrane to prevent the flow/segregation of the membrane at the time of recording/erasure and super-resolving reading.



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1. This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.

3. In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1] It sets to the thin film for information record which records and reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam, and the average presentation of the direction of thickness of said thin film for information record is a general formula $SbxTeyApBqCr$. (1)

At least one element chosen from the 1st group to which it is expressed, and which it appears, and said A becomes from germanium and In, At least one element chosen from the 2nd group which said B becomes from a lanthanoids, and Ag, Ba, Co, Cr, nickel, Pt, Si, Sr, Au, Cd, Cu, Li, Mo, Mn, Zn, aluminum, Fe, Pb, Na, Cs, Ga, Pd, Bi, Sn, Ti and V, Said C expresses at least one element other than the element expressed with Sb, Te, and said A and B, and each unit of said x, and y, p, q and r is an atomic ratio. The thin film for information record characterized by being in the range of $2 \leq x \leq 41$, $25 \leq y \leq 75$, $0.1 \leq p \leq 60$, $3 \leq q \leq 40$, and $0.1 \leq r \leq 30$, respectively.

[Claim 2] It sets to the thin film for information record which records and reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam, and the average presentation of the direction of thickness of said thin film for information record is a general formula $SbxTeyApBq$. (2)

At least one element chosen from the 1st group to which it is expressed, and which it appears, and said A becomes from germanium and In, Said B expresses at least one element chosen from the 2nd group which consists of a lanthanoids, and Ag, Ba, Co, Cr, nickel, Pt, Si, Sr, Au, Cd, Cu, Li, Mo, Mn, Zn, aluminum, Fe, Pb, Na, Cs, Ga, Pd, Bi, Sn, Ti and V. Each unit of said x, and y, p and q is a thin film for information record which is an atomic ratio and is characterized by being in the range of $2 \leq x \leq 41$, $25 \leq y \leq 75$, $0.1 \leq p \leq 60$, and $3 \leq q \leq 40$, respectively.

[Claim 3] It sets to the thin film for information record which records and reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam, and the average presentation of the direction of thickness of said thin film for information record is a general formula $SbxTeyBqCr$. (3)

At least one element chosen from the group to which it is expressed, and which it appears, and said B becomes from a lanthanoids, and Ag, Ba, Co, Cr, nickel, Pt, Si, Sr, Au, Cd, Cu, Li, Mo, Mn, Zn, aluminum, Fe, Pb, Na, Cs, Ga, Pd, Bi, Sn, Ti and V, Said C expresses at least one element other than the element expressed with Sb, Te, and said B, and each unit of said x, and y, p and q is an atomic ratio. The thin film for information record characterized by being in the range of $2 \leq x \leq 41$, $25 \leq y \leq 75$, $3 \leq q \leq 40$, and $0.1 \leq r \leq 30$, respectively.

[Claim 4] It sets to the thin film for information record which records and reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam, and the average presentation of the direction of thickness of said thin film for information record is a general formula $SbxTeyBq$. (4)

It is come out and expressed. Said B expresses at least one element chosen from the group which consists of a lanthanoids, and Ag, Ba, Co, Cr, nickel, Pt, Si, Sr, Au, Cd, Cu, Li, Mo, Mn, Zn, aluminum, Fe, Pb, Na, Cs, Ga, Pd, Bi, Sn, Ti and V. Each unit of said x, and y and q is a thin film for information record which is an atomic ratio and is characterized by being in the range of $2 \leq x \leq 41$, $25 \leq y \leq 75$, and $3 \leq q \leq 40$, respectively.

[Claim 5] It sets to the thin film for information record which records and reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is

produced in response to the exposure of a energy beam, and the average presentation of the direction of thickness of said thin film for information record is general formula (GeaSbbTec) 1-dXd. (5)

It is come out and expressed. Said X expresses Cr, Ag, Ba, Co, nickel, Pt, Si, Sr, Au, Cd, Cu, Li, Mo, Mn, Zn, aluminum, Fe, Pb, Na, Cs, Ga, Pd, Bi, Sn, Ti, V, In, W and Zn, and at least one element of a lanthanoids. The thin film for information record with which said a, b, c, and d are characterized by being in the range of $0.02 \leq a \leq 0.19$, $0.04 \leq b \leq 0.4$, $0.5 \leq c \leq 0.75$, and $0.03 \leq d \leq 0.3$, respectively, respectively.

[Claim 6] It sets to the thin film for information record which records and reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam, and the average presentation of the direction of thickness of said thin film for information record is general formula (GeaSbbTec) 1-dXd. (5)

It is come out and expressed. Said X expresses Cr, Ag, Ba, Co, nickel, Pt, Si, Sr, Au, Cd, Cu, Li, Mo, Mn, Zn, aluminum, Fe, Pb, Na, Cs, Ga, Pd, Bi, Sn, Ti, V, In, W and Zn, and at least one element of a lanthanoids. The thin film for information record with which said a, b, c, and d are characterized by being in the range of $0.25 \leq a \leq 0.65$, $0 \leq b \leq 0.2$, $0.35 \leq c \leq 0.75$, and $0.03 \leq d \leq 0.3$, respectively.

[Claim 7] The thin film for information record according to claim 1 to 6 characterized by either [said / at least] B or X having a concentration gradient in the direction of thickness.

[Claim 8] The thin film for information record according to claim 1 to 6 with which the sludge with which the melting point consists of a high high-melting component relatively is included from the residual element of the thin film concerned, and the sludge contains the element expressed with either [said / at least] B or X.

[Claim 9] The thin film for information record given in either of claims 1, 2, 5, and 6 characterized by including the sludge with which the melting point consists of a high high-melting component relatively from the residual element of the thin film concerned, and a part of high-melting component [at least] existing in the optical incidence side of the thin film concerned in the range of 1-10nm of average thickness in the shape of discontinuous film.

[Claim 10] The thin film for information record given in either of claims 1, 2, 5, and 6 which contain the sludge with which the melting point consists of a high high-melting component relatively from the residual element of the thin film concerned, and have the sum of the atomic number of the configuration element of a high-melting component in 10 - 50% of range to the sum of all the atomic numbers of the configuration element of the thin film concerned.

[Claim 11] The thin film for information record given in either of claims 1, 2, 5, and 6 characterized by including the sludge with which the melting point consists of a high high-melting component relatively from the residual element of the thin film concerned, and a high-melting quantitative formula changing in the direction of thickness.

[Claim 12] The sludge with which the melting point consists of a high high-melting component relatively is included from the residual element of the thin film concerned, and it is $LjHk$ about the average presentation of the thin film concerned by the high-melting component H of an element simple substance, the low-melt point point component L of a compound presentation and an element simple substance, or a compound presentation. (6)

When expressed with a ** type, it is $20 \leq k/(j+k) \leq 40$. It is a thin film for information record given in either of claims 1, 2, 5, and 6 which consider the presentation which is (7) as a criteria presentation, and are characterized by the content in the inside of the film of each element which constitutes the above-mentioned thin film for information record being within the limits of value**10 atom % decided by said formula.

[Claim 13] The thin film for information record given in either of claims 1, 2, 5, and 6 whose melting points of a high-melting component the sludge with which the melting point consists of a high high-melting component relatively is included from the residual element of the thin film concerned, and are more than 780-degreeC.

[Claim 14] The thin film for information record given in either of claims 1, 2, 5, and 6 whose differences of the melting point of a high-melting component and the melting point of the residual element of the thin film concerned the sludge with which the melting point consists of a high high-melting component relatively is included from the residual element of the thin film concerned, and are more than 150-degreeC.

[Claim 15] That the sludge with which the melting point consists of a high high-melting component relatively is included from the residual element of the thin film concerned, and the thin film concerned of the sludge of a high-melting component is granular inside, or the thin film for information record given in either of claims 1, 2, 5, and 6 distributed in the shape of a column.

[Claim 16] The thin film for information record given in either of claims 1, 2, 5, and 6 whose dimensions outside max in the direction of a film surface of the thin film of the sludge of a high-melting component concerned the sludge with which the melting point consists of a high high-melting component relatively is

included from the residual element of the thin film concerned, and are 5nm or more and 50nm or less.

[Claim 17] The thin film for information record given in either of claims 1, 2, 5, and 6 whose thickness lay length of a sludge the sludge with which the melting point consists of a high high-melting component relatively is included from the residual element of the thin film concerned, the sludge of a high-melting component is prolonged in the shape of a column in the direction of thickness from the interface of both thin films concerned, and is the following (1/2) of the thickness of the thin film concerned in 5nm or more.

[Claim 18] The thin film for information record given in either of claims 1, 2, 5, and 6 whose thickness lay length of said sludge the sludge with which the melting point consists of a high high-melting component relatively is included from the residual element of the thin film concerned, the sludge of a high-melting component is prolonged in the shape of a column in the direction of thickness from one interface of the thin film concerned, and is below the thickness of the thin film concerned in 10nm or more.

[Claim 19] The thin film for information record given in either of claims 1, 2, 5, and 6 whose thickness lay length of the sludge of a high-melting component the sludge with which the melting point consists of a high high-melting component relatively is included from the residual element of the thin film concerned, and is below the thickness of the thin film concerned in 10nm or more.

[Claim 20] The thin film for information record given in either of claims 1, 2, 5, and 6 whose die length to which the straight line which connects the center to center of the sludge of said two high-melting components which contains the sludge with which the melting point consists of a high high-melting component relatively from the residual element of the thin film concerned, and adjoin passes along the field between these sludges by the direction of a film surface of the thin film concerned is 20nm or more and 90nm or less.

[Claim 21] The thin film for information record given in either of claims 1, 2, 5, and 6 from which the porous sludge with which the melting point consists of a high high-melting component relatively is included from the residual element of the thin film concerned, and the residual element concerned is distributed in the hole of said porosity sludge.

[Claim 22] The thin film for information record given in either of claims 1, 2, 5, and 6 whose maximum wall thickness in the direction of a film surface of the thin film of the field between said holes which are adjoining two concerned the sludge with which the melting point consists of a high high-melting component relatively is included from the residual element of the thin film concerned, the maximum hole dimension in the direction of a film surface of the thin film of the hole of the porosity-like sludge of a high-melting component concerned is 80nm or less, and is 20nm or less.

[Claim 23] The thin film for information record given in either of claims 1, 2, 5, and 6 whose melting points of the residual element of the thin film concerned the sludge with which the melting point consists of a high high-melting component relatively is included from the residual element of the thin film concerned, and are below 650-degreeC.

[Claim 24] The thin film for information record given in either of claims 1, 2, 5, and 6 whose melting points of the residual element of the thin film concerned the sludge with which the melting point consists of a high high-melting component relatively is included from the residual element of the thin film concerned, and are below 250-degreeC.

[Claim 25] The thin film for information record given in either of claims 1, 2, 5, and 6 from which the sludge with which the melting point consists of a high high-melting component relatively is included from the residual element of the thin film concerned, and either [at least] the real part of the complex index of refraction of the thin film concerned or imaginary part changes with the exposures of light 20% or more to it before an exposure.

[Claim 26] The thin film for information record characterized by to be distributed in the field where the sludge with which the melting point consists of a high high-melting component relatively from the residual element of the thin film concerned is included, and the sludge consists of a residual element of the thin film concerned in the thin film for information record which records and reproduces information by atomic-arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam.

[Claim 27] The thin film for information record according to claim 26 whose dimensions outside max in the direction of a film surface of the thin film of the sludge of said high-melting component concerned are 5nm or more and 50nm or less.

[Claim 28] The thin film for information record according to claim 26 whose thickness lay length of said sludge the sludge of said high-melting component is prolonged in the shape of a column in the direction of thickness from the interface of both thin films concerned, and is the following (1/2) of the thickness of the thin film concerned in 5nm or more.

[Claim 29] The thin film for information record according to claim 26 whose thickness lay length of said sludge the sludge of said high-melting component is prolonged in the shape of a column in the direction of thickness from one interface of the thin film concerned, and is below the thickness of the thin film concerned in 10nm or more.

[Claim 30] The thin film for information record according to claim 26 whose thickness lay length of the sludge of said high-melting component is below the thickness of the thin film concerned in 10nm or more.

[Claim 31] The thin film for information record according to claim 26 whose die length to which the straight line which connects the center to center of the sludge of said two adjoining high-melting components passes along the field between these sludges by the direction of a film surface of the thin film concerned is 20nm or more and 90nm or less.

[Claim 32] The thin film for information record characterized by to include the porous sludge with which the melting point consists of a high high-melting component relatively from the residual element of the thin film concerned in the thin film for information record which records and reproduces information, and to be distributed the residual element of the thin film concerned in the hole of said porosity sludge by atomic-arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam.

[Claim 33] The thin film for information record according to claim 32 whose maximum wall thickness in the direction of a film surface of the thin film of the field between said holes which are adjoining two concerned the maximum inside dimension method in the direction of a film surface of the thin film of the hole of the porosity-like sludge of said high-melting component concerned is 80nm or less, and is 20nm or less.

[Claim 34] The thin film for information record according to claim 26 or 32 whose melting point of the residual element of the thin film concerned is below 650-degreeC.

[Claim 35] The thin film for information record according to claim 26 or 32 whose melting point of the residual element of the thin film concerned is below 250-degreeC.

[Claim 36] The thin film for information record according to claim 26 or 32 from which either [at least] the real part of the complex index of refraction of the thin film concerned or imaginary part changes with the exposures of light 20% or more to it before an exposure.

[Claim 37] The thin film for information record according to claim 26 or 32 which has the sum of the atomic number of the configuration element of said high-melting component in 10 – 50% of range to the sum of all the atomic numbers of the thin film concerned.

[Claim 38] About an average presentation, it is $LjHk$ by the high-melting component H of an element simple substance, the low-melt point point component L of a compound presentation and an element simple substance, or a compound presentation. (6)

the time of expressing with a ** type -- $20 \leq k/(j+k) \leq 40$ (7) it is -- thin film for information record according to claim 26 or 32 which considers a presentation as a criteria presentation and is characterized by the content in the inside of the film of each element which constitutes the above-mentioned thin film for information record being within the limits of value**10 atom % decided by said formula.

[Claim 39] The thin film for information record according to claim 26 or 32 whose melting point of said high-melting component is more than 780-degreeC.

[Claim 40] The thin film for information record according to claim 26 or 32 whose difference of the melting point of said high-melting component and the melting point of the residual element of the thin film concerned is more than 150-degreeC.

[Claim 41] The thin film for information record given in either of claims 1, 2, 5, and 6 whose elements expressed with either [said / at least] B or X are Cr .

[Claim 42] The thin film for information record given in either of claims 1, 2, 5, and 6 whose elements expressed with either [said / at least] B or X are Mo , and Si , Pt , Co , Mn and W .

[Claim 43] The manufacture approach of the thin film for information record which is the manufacture approach of the thin film for information record which records and reproduces information by atomic-arrangement change which was formed through direct or a protective layer on a substrate, and which produces in response to the exposure of a energy beam, and characterizes by coming to have the process which forms a thin film through direct or a protective layer on a substrate, and the process which a energy beam irradiates [process], and generate or grow up a high-melting component into said thin film into said thin film.

[Claim 44] It is the manufacture approach of the thin film for information record which records and reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam. The process which is made to put the ingredient which has the presentation near the presentation of the ingredient of a high-

melting component, or a high-melting component through direct or a protective layer on a substrate, and forms island-shape seed crystal. The manufacture approach of the thin film for information record characterized by coming to have the process into which said residual element is grown up so that between these seed crystal may be filled while making the ingredient containing said high-melting component and said residual element put on said seed crystal and growing up said high-melting component on said seed crystal alternatively.

[Claim 45] The manufacture approach of the thin film for information record which is the manufacture approach of the thin film for information record which records or reproduces information by atomic-arrangement change which was formed through direct or a protective layer on a substrate, and which produces in response to the exposure of a energy beam, and is characterized by to have the process which changes the content of a high-melting component in the direction of thickness at the time of formation of the film which consists of a phase change component and a high-melting component through direct or a protective layer on a substrate.

[Claim 46] Claims 1-6, the information record medium which equipped either 26 and 32 with the thin film for information record of a publication as a recording layer.

[Claim 47] Claims 1-6, the information record medium which equipped either 26 and 32 with the thin film for information record of a publication as a mask layer for super resolution read-out.

[Claim 48] Claims 1-6, the information record medium which equipped either 26 and 32 with the thin film for information record of a publication as a reflecting layer for super resolution read-out.

[Claim 49] Claims 1-6 whose melting points of said residual element after a deposit of said high-melting component are below 650-degreeC, the information record medium which equipped either 26 and 32 with the thin film for information record of a publication.

[Claim 50] Claims 1-6 whose reflection factors of said reflecting layer are 60% or more, the information record medium which equipped either 26 and 32 with the thin film for information record of a publication.

[Claim 51] The information record medium equipped with the interlayer of the two-layer structure of the layer which equips either [claims 1-6 and] 26 and 32 with the thin film for information record of a publication as a recording layer or a mask layer for super resolution read-out, and contains Si in a reflecting layer side, and the layer which uses ZnS as a principal component at a record film side.

[Claim 52] The information record medium which was equipped with the thin film for information record which records or reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam as a recording layer or a mask layer for super resolution read-out, and was equipped with the reflecting layer which is the presentation near at least one of Si-Sn, Si-germanium, and the Si-In compounds, or this.

[Claim 53] The information record medium in which is equipped with the thin film for information record which records or reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam as a recording layer or a mask layer for super resolution read-out, and the thickness of a reflecting layer has the 150nm or more description which is 300nm or less.

[Claim 54] The information record medium which was equipped with the thin film for information record which records or reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam as a recording layer or a mask layer for super resolution read-out, and equipped the optical incidence side with the protective layer of ZnS-SiO two-layer two-layer structure at the SiO two-layer and record film side.

[Claim 55] It is the thin film for super resolution read-out which is a thin film for super resolution read-out which is formed through direct or a protective layer on a substrate, and produces the super resolution effectiveness in response to the exposure of the beam for read-out, and is characterized by the high-melting component depositing including a high-melting component at least with the melting point higher than a phase change component and this phase change component.

[Claim 56] Said high-melting component is pillar-shaped or a thin film for super resolution read-out according to claim 55 characterized by depositing as a massive sludge.

[Claim 57] Said high-melting component is a thin film for super resolution read-out according to claim 55 characterized by depositing as a porosity-like sludge.

[Claim 58] It is the thin film for super resolution read-out which is formed through direct or a protective layer on a substrate, and produces the super resolution effectiveness in response to the exposure of the beam for read-out. At least one element with which the average presentation was expressed with the general formula DeEfFg, and said D was chosen from Sn, Pb, Bi, Zn, Ga, and In, Said E As, B, C, N, O, S, Se, Si, Te, Ag, aluminum, Au, Ba, Be, calcium, Cd, Co, Cr, Cs, Cu, Fe, germanium, Hf, Hg, Ir, K, Li, Mg, Mn, Mo, Na, Nb, nickel,

Os, Pd, Pt, Rb, Re; Rh, Ru, Sb, At least one element chosen from the group which consists of Sc, Sr, Ta, Ti, V, W, Y, and Zr, and said F express at least one element except being expressed with said D and said E, and said each of units of e, f, and g is atomic ratios. The thin film for super resolution read-out according to claim 55 characterized by being in the range of $30 \leq e \leq 95$, $5 \leq f \leq 50$, and $0 \leq g \leq 20$, respectively.

[Claim 59] About an average presentation, it is $L_j H_k$ by the high-melting component H of an element simple substance, the low-melt point point component L of a compound presentation and an element simple substance, or a compound presentation. (6)

the time of expressing with a ** type -- $20 \leq k/(j+k) \leq 40$ (7) it is -- thin film for super resolution read-out according to claim 55 which considers a presentation as a criteria presentation and is characterized by the content in the inside of the film of each element being within the limits of value**10 atom % decided by said formula.

[Claim 60] The thin film for super resolution read-out according to claim 55 characterized by each of low-melt point point components and high-melting components containing a metal or metalloid element more than 50 atom %.

[Claim 61] The information record medium characterized by having prepared the thin film for super resolution read-out indicated by claim 55 on the transparence substrate with which information was recorded, and preparing a reflecting layer on it with irregularity.

[Claim 62] The information record medium characterized by preparing the protective layer between the thin films for super resolution read-out indicated by the transparence substrate with which information was recorded by irregularity, and claim 55.

[Claim 63] The information record medium characterized by preparing the interlayer between the thin film for super resolution read-out indicated by claim 55, and a reflecting layer.

[Claim 64] The information record medium characterized by having prepared the thin film for super resolution read-out indicated by claim 55 on the transparence substrate, having formed information record film on it, and preparing a reflecting layer on it further.

[Claim 65] The information record medium characterized by preparing the protective layer between the thin films for super resolution read-out indicated by the transparence substrate and claim 55.

[Claim 66] The information record medium characterized by preparing the interlayer between the thin film for super resolution read-out indicated by claim 55, and information record film, or in either [at least] between information record film and a reflecting layer.

[Claim 67] Equipment for super-resolution read-out characterized by to have a means detect turbulence of the intensity distribution of the reflected light at the time of super resolution read-out, and a means adjust laser power according to the above-mentioned scale of turbulence, in the equipment for super-resolution read-out equipped with the information record medium equipped with the thin film for super resolution read-out indicated by claim 55, and the optical head which irradiates a laser beam at said information record medium, and detects the reflected light.

[Claim 68] In the equipment for super resolution read-out equipped with the information record medium equipped with the thin film for super resolution read-out according to claim 55, and the optical head which irradiates a laser beam at said information record medium, and detects the reflected light, said laser beam is pulsed light, and the relation of the period T of a laser pulse, linear velocity v, the diameter of a spot (λ/NA), and pulse width x is $0.4 \lambda/NA \leq vT \leq 1.5 \lambda/NA$. (9)
and -- $0.3 \leq x/T \leq 0.5$ (10)

***** -- the equipment for super resolution read-out characterized by things.

[Claim 69] It is equipment for super-resolution read-out characterized by to have a means set the output of a laser beam as the output which does not dissolve the whole film in the field used as the maximum temperature of the thin film for super resolution read-out, either in the equipment for super resolution read-out equipped with the information record medium equipped with the thin film for super resolution read-out according to claim 55, and the optical head which irradiates a laser beam at said information record medium, and detects the reflected light.

[Claim 70] In the thin film for information record which records and reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam By repeating a laser beam and irradiating it in the informational record regenerative apparatus or the equipment for initial crystallization of a medium using the medium for information record which has the thin film concerned The thin film for information record characterized by being distributed in the field where a high-melting component with the high melting point deposits relatively, and the sludge consists of a residual element of the thin film concerned from the residual element of the thin film concerned.

[Claim 71] Were formed through direct or a protective layer on the substrate. By repeating a laser beam and irradiating it in the informational record playback approach or the approach for initial crystallization of a medium using the medium for information record which has the thin film for information record which records and reproduces information, by atomic arrangement change produced in response to the exposure of a energy beam The record playback approach of the information characterized by making it distributed in the field where a high-melting component with the high melting point deposits relatively, and the sludge consists of a residual element of the thin film concerned from the residual element of the thin film concerned.

[Claim 72] By repeating a laser beam and irradiating it in the thin film concerned, in the informational record regenerative apparatus or the equipment for initial crystallization of a medium using the medium for information record which has the thin film concerned The thin film for information record according to claim 1 to 6 with which a high-melting component with the high melting point deposits more relatively than the residual element of the thin film concerned, it is distributed in the field where the sludge consists of a residual element of the thin film concerned, and the sludge is characterized by including the element expressed with either [said / at least] B or X.

[Claim 73] It is the manufacture approach of the medium for information record which records and reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam. The process which forms a protective layer, record film or the super resolution readout film, an interlayer, and a reflecting layer on a substrate, The manufacture approach of the medium for information record characterized by coming to have the process which a energy beam is irradiated [process], and generates or grows up a high-melting component into the process which sticks on this another substrate or another substrate which formed said each class similarly, and said medium into said thin film.

[Claim 74] It is the manufacture approach of the medium for information record which records and reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam. The process which is made to put an ingredient with the presentation near the presentation of the ingredient of the process which forms a protective layer on a substrate, and a high-melting component, or a high-melting component, and forms island-shape seed crystal, While making the ingredient containing said high-melting component and said residual element put on said seed crystal and growing up said high-melting component on said seed crystal alternatively The manufacture approach of the medium for information record characterized by coming to have with the process into which said residual element is grown up so that between these seed crystal may be filled, the process which forms an interlayer and a reflecting layer, and the process which sticks on this another substrate or another substrate which formed said each class similarly.

[Claim 75] The process which is the manufacture approach of the medium for information record which records or reproduces information, and forms a protective layer on a substrate by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam, The process which changes the content of a high-melting component in the direction of thickness, forming the film which consists of a phase change component and a high-melting component, The manufacture approach of the medium for information record characterized by having the process which forms an interlayer and a reflecting layer, and the process which sticks on this another substrate or another substrate which formed said each class similarly.

[Translation done.]

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- 2.**** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] If this invention says in more detail about the thin film for information record, its manufacture approach, and an information record medium Digital information, such as information, data of a computer, a facsimile signal, a digital audio signal, etc. which carried out FM modulation and acquired analog signals, such as an image and voice, for example, a laser beam, It is related with the information record medium using the thin film for information record which can be recorded and reproduced on real time by energy beams, such as an electron ray, or the thin film for super resolution read-out, its manufacture approach and its thin film for information record, or the thin film for super resolution read-out.

[0002]

[Description of the Prior Art] Although various principles which irradiate a laser beam and record information on a thin film (record film) are known, it has the advantage in which phase transition (called the phase change), photograph dark NINGU, etc. of a film ingredient stick the disk member of two sheets directly since the thing using the atomic arrangement change by the exposure of a laser beam is hardly accompanied by deformation of a thin film, and the information record medium of double-sided disk structure is obtained. Moreover, there is an advantage which can rewrite information in the record film of a GeSbTe system or an InSbTe system.

[0003] However, in this kind of record film, if many rewritings which exceed 104 times in pit edge record 105 times are performed in pit position record, since it will rewrite by flow of record film and a property will fall, the method of preventing a flow of record film is studied. By the laser radiation at the time of record, record film flows, record film is pushed little by little by deformation by the thermal expansion of a protective layer or an interlayer, and a flow of record film is produced.

[0004] For example, the method of preventing a flow by microcell-ization of record film is indicated by JP,4-228127,A, and it is reference. Record film is made thin and the method of preventing a flow of record film using the effect of adhesion force with the layer which lowers heat capacity and adjoins becoming large is indicated by T.Ohta et al."Optical Data Strage"'89 Proc.SPIE, 1078, and 27 (1989).

[0005] The analog information signal which carried out FM modulation of a video signal, the sound signal, etc., and the data of a computer, The optical disk which imprinted digital information signals, such as a facsimile signal and a digital audio signal, as irregularity on the substrate front face, In the optical disk which has the thin film for record of the information which can record a signal and data on real time by beams for record, such as a laser beam and an electron ray, etc. Most signal re-biodegradation ability is decided by the wavelength lambda of the light source of playback optical system, and the numerical aperture NA of an objective lens, and record mark period 2 NA/lambda reads it, and it is limitations.

[0006] The medium with the melting mask layer for carrying out high density playback of the data which the approach of reproducing the data recorded with irregularity as technique for a raise in recording density using the medium from which a reflection factor changes with phase changes was indicated by JP,3-292632,A, and were recorded on phase change record film is indicated by JP,5-73961,A.

[0007] In addition, on these specifications, the vocabulary a "phase change" is used as a thing not only including the phase change between crystal-amorphous but fusion (change to the liquid phase), recrystallization, and the phase change between crystallized state-crystallized states.

[0008]

[Problem(s) to be Solved by the Invention] When using as record film of a rewritable phase transition mold, each conventional record film has the problem of regenerative-signal reinforcement becoming less enough etc., if the ** [to which a crystallization rate will become slow if a ** rewritable count is made / many] rewritable count whose ** rewritable count is not enough is made [many].

[0009] Then, the purpose of this invention is to offer the information record medium using the thin film for information record in which many rewritings are more possible than before, its manufacture approach, and its thin film, holding good record and reproducing characteristics.

[0010] Moreover, an approach given in JP,3-292632,A is Sb2Se3. Using the film, a phase change is partially carried out within the scan spot of read-out light, a reflection factor is changed, and the phase pit only in a high reflection factor field is read. By this approach, since the melting point of the above-mentioned film is an elevated temperature, the exposure power of laser is high and it cannot apply to phase-change optical disks other than the optical disk which recorded information in the phase pit, a magneto-optic disk, etc.

Furthermore, if many read-out is repeated, a membranous flow and a segregation will arise little by little, and there is a fault, like there are few counts which can be super resolution read. Moreover, using a melting mask layer, a medium given in JP,5-73961,A is partially fused within the scan spot of read-out light, changes a reflection factor, and makes spot size small seemingly. By this medium, the melting mask layer with the low melting point is used, since viscosity is low, if many read-out is repeated, a membranous flow and a

segregation will arise little by little, and there is a fault, like there are few counts which can be super resolution read.

[0011] Then, other purposes of this invention are by canceling the fault of the above-mentioned conventional technique, being able to apply to the optical disk with which digital information signals, such as analog information signals, such as a video signal and a sound signal, and data of a computer, a facsimile signal, a digital audio signal, were recorded by irregularity, a phase-change optical disk, a magneto-optic disk, etc., and preventing a flow and a segregation to offer the thin film for super resolution read-out which increased the count which can be super resolution read.

[0012]

[Means for Solving the Problem]

(1) Set the 1st thin film for information record of this invention to the thin film for information record which records and reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam, and the average presentation of the direction of thickness of said thin film for information record is a general formula $SbxTeyApBqCr$. (1)

At least one element chosen from the 1st group to which it is expressed, and which it appears, and said A becomes from germanium and In, Said B A lanthanoids And Ag, Ba, Co, Cr, nickel, Pt, Si, Sr, Au, Cd, Cu, Li, Mo, Mn, Zn, aluminum, Fe, Pb, Na, Cs, Ga, Pd, Bi, (La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu) At least one element chosen from the 2nd group which consists of Sn, Ti, and V, Said C expresses at least one element other than the element expressed with Sb, Te, and said A and B, and each unit of said x, and y, p, q and r is an atomic ratio. It is characterized by being in the range of $2 \leq x \leq 41$, $25 \leq y \leq 75$, $0.1 \leq p \leq 60$, $3 \leq q \leq 40$, and $0.1 \leq r \leq 30$, respectively.

[0013] (2) Set the 2nd thin film for information record of this invention to the thin film for information record which records and reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam, and the average presentation of the direction of thickness of said thin film for information record is a general formula $SbxTeyApBq$. (2)

At least one element chosen from the 1st group to which it is expressed, and which it appears, and said A becomes from germanium and In, Said B expresses at least one element chosen from the 2nd group which consists of a lanthanoids, and Ag, Ba, Co, Cr, nickel, Pt, Si, Sr, Au, Cd, Cu, Li, Mo, Mn, Zn, aluminum, Fe, Pb, Na, Cs, Ga, Pd, Bi, Sn, Ti and V. Each unit of said x, and y, d and e is an atomic ratio, and it is characterized by being in the range of $2 \leq x \leq 41$, $25 \leq y \leq 75$, $0.1 \leq p \leq 60$, and $3 \leq q \leq 40$, respectively.

[0014] This is equivalent to the thing except the element expressed with said C of said 1st thin film for information record.

[0015] (3) Set the 3rd thin film for information record of this invention to the thin film for information record which records and reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam, and the average presentation of the direction of thickness of said thin film for information record is a general formula $SbxTeyBqCr$. (3)

At least one element chosen from the group to which it is expressed, and which it appears, and said B becomes from a lanthanoids, and Ag, Ba, Co, Cr, nickel, Pt, Si, Sr, Au, Cd, Cu, Li, Mo, Mn, Zn, aluminum, Fe, Pb, Na, Cs, Ga, Pd, Bi, Sn, Ti and V, Said C expresses at least one element other than the element expressed with Sb, Te, and said B, and each unit of said x, and y, e and f is an atomic ratio, and it is characterized by being in the range of $2 \leq x \leq 41$, $25 \leq y \leq 75$, $3 \leq q \leq 40$, and $0.1 \leq r \leq 30$, respectively.

[0016] This is equivalent to the thing except the element expressed with said A of said 1st thin film for information record.

[0017] (4) Set the 4th thin film for information record of this invention to the thin film for information record which records and reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam, and the average presentation of the direction of thickness of said thin film for information record is a general formula $SbxTeyBq$. (4)

It is come out and expressed. Said B expresses at least one element chosen from the group which consists of a lanthanoids, and Ag, Ba, Co, Cr, nickel, Pt, Si, Sr, Au, Cd, Cu, Li, Mo, Mn, Zn, aluminum, Fe, Pb, Na, Cs, Ga, Pd, Bi, Sn, Ti and V. Each unit of said x, and y and e is an atomic ratio, and it is characterized by being in the range of $2 \leq x \leq 41$, $25 \leq y \leq 75$, and $3 \leq q \leq 40$, respectively.

[0018] This is equivalent to the thing except the element expressed with said A and C of said 1st thin film for information record.

[0019] (5) Set the thin film for information record of this invention to the thin film for information record which records and reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam, and the average presentation of said thin film for information record is general formula (GeaSbbTec) 1-dXd. (5) Come out, and it is expressed and said X expresses at least one element which consists of Cr(s), Ag, Ba, Co, nickel, Pt, Si, Sr, Au, Cd, Cu, Li, Mo, Mn, Zn, aluminum, Fe, Pb, Na, Cs, Ga, Pd, Bi, Sn, Ti, V and In(s), and lanthanoidses. Said a, b, c, and d are characterized by being in the range of $0.02 \leq a \leq 0.19$, $0.04 \leq b \leq 0.4$, $0.5 \leq c \leq 0.75$, and $0.03 \leq d \leq 0.3$, respectively.

[0020] (6) Set the thin film for information record of this invention to the thin film for information record which records and reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam, and the average presentation of said thin film for information record is general formula (GeaSbbTec) 1-dXd. (5) Come out, and it is expressed and said X expresses at least one element which consists of Cr(s), Ag, Ba, Co, nickel, Pt, Si, Sr, Au, Cd, Cu, Li, Mo, Mn, Zn, aluminum, Fe, Pb, Na, Cs, Ga, Pd, Bi, Sn, Ti, V and In(s), and lanthanoidses. Said a, b, c, and d are characterized by being in the range of $0.25 \leq a \leq 0.65$, $0 \leq b \leq 0.2$, $0.35 \leq c \leq 0.75$, and $0.03 \leq d \leq 0.3$, respectively.

[0021] (7) In the thin film for information record given in either [said] 1-6, it is characterized by said B or X having a concentration gradient in the direction of thickness.

[0022] (8) It is characterized by including the sludge with which the melting point consists of a high high-melting component relatively from the residual element of the thin film concerned in the thin film for information record of a publication in either [said] 1-6, and the sludge containing the element expressed with said B or said X.

[0023] (9) The sludge with which the melting point consists of a high high-melting component relatively from the residual element of the thin film concerned in the thin film for information record of a publication is included in either [said] 2, 5 and 6, and a part of high-melting component [at least] is characterized by existing in the optical incidence side of the thin film concerned in the range of 1-10nm of average thickness in the shape of discontinuous film.

[0024] (10) It is characterized by including the sludge with which the melting point consists of a high high-melting component relatively from the residual element of the thin film concerned in the thin film for information record of a publication in either [said] 2, 5 and 6, and the sum of the atomic number of the configuration element of a high-melting component being in 10 - 50% of range to the sum of all the atomic numbers of the configuration element of the thin film concerned.

[0025] (11) It is characterized by including the sludge with which the melting point consists of a high high-melting component relatively from the residual element of the thin film concerned, and a high-melting quantitative formula changing in the direction of thickness in the thin film for information record of a publication, to either [said] 2, 5 and 6.

[0026] (12) In the thin film for information record of a publication, the sludge with which the melting point consists of a high high-melting component relatively from the residual element of the thin film concerned is included in either [said] 2, 5 and 6, and it is $LjHk$ about the average presentation of the thin film concerned by the high-melting component H of an element simple substance, the low-melt point point component L of a compound presentation and an element simple substance, or a compound presentation. (6) the time of expressing with a ** type -- $20 \leq k/(j+K) \leq 40$ (7) it is -- a presentation is considered as a criteria presentation and it is characterized by the content in the inside of the film of each element being within the limits of value**10 atom % decided by said formula.

[0027] (13) In the thin film for information record of a publication, the sludge with which the melting point consists of a high high-melting component relatively from the residual element of the thin film concerned is included in either [said] 2, 5 and 6, and it is characterized by the melting point of a high-melting component being more than 780-degreeC.

[0028] (14) In the thin film for information record of a publication, the sludge with which the melting point consists of a high high-melting component relatively from the residual element of the thin film concerned is included in either [said] 2, 5 and 6, and it is characterized by the difference of the melting point of a high-melting component and the melting point of the residual element of the thin film concerned being more than 150-degreeC.

[0029] (15) In the thin film for information record of a publication, the sludge with which the melting point consists of a high high-melting component relatively from the residual element of the thin film concerned is included in either [said] 2, 5 and 6, and the sludge of a high-melting component is characterized by granular or being distributed in the shape of a column inside the thin film concerned.

[0030] (16) In the thin film for information record of a publication, the sludge with which the melting point consists of a high high-melting component relatively from the residual element of the thin film concerned is included in either [said] 2, 5 and 6, and it is characterized by the dimensions outside max in the direction of a film surface of the thin film of the sludge of a high-melting component concerned being 5nm or more and 50nm or less.

[0031] (17) The sludge with which the melting point consists of a high high-melting component relatively from the residual element of the thin film concerned in the thin film for information record of a publication is included in either [said] 2, 5 and 6, the sludge of a high-melting component is prolonged in the shape of a column in the direction of thickness from the interface of both thin films concerned, and thickness lay length of a sludge is characterized by being the following (1/2) of the thickness of the thin film concerned by 5nm or more.

[0032] (18) The thin film for information record according to claim 9 or 10 whose thickness lay length of a sludge the sludge with which the melting point consists of a high high-melting component relatively from the residual element of the thin film concerned in the thin film for information record of a publication is included in either [said] 2, 5 and 6, the sludge of a high-melting component is prolonged in the shape of a column in the direction of thickness from one interface of the thin film concerned, and is below the thickness of the thin film concerned in 10nm or more.

[0033] (19) In the thin film for information record of a publication, the sludge with which the melting point consists of a high high-melting component relatively from the residual element of the thin film concerned is included in either [said] 2, 5 and 6, and thickness lay length of the sludge of a high-melting component is characterized by being below the thickness of the thin film concerned by 10nm or more.

[0034] (20) It is characterized by the die length to which the straight line which connects the center to center of the sludge of two high-melting components which contain the sludge with which the melting point consists of a high high-melting component relatively from the residual element of the thin film concerned in the thin film for information record of a publication, and adjoin either [said] 2, 5 and 6 passes along the field between these sludges by the direction of a film surface of the thin film concerned being 15nm or more and 70nm or less.

[0035] (21) The porous sludge with which the melting point consists of a high high-melting component relatively from the residual element of the thin film concerned in the thin film for information record of a publication is included in either [said] 2, 5 and 6, and it is characterized by distributing the residual element concerned in the hole of said porosity sludge.

[0036] (22) In the thin film for information record given in either [said] 2, 5 and 6 The porous sludge with which the melting point consists of a high high-melting component more relatively than the residual element of the thin film concerned is included. It is characterized by for the maximum hole dimension in the direction of a film surface of the thin film of the hole of the porosity-like sludge of a high-melting component concerned being 80nm or less, and the maximum wall thickness in the direction of a film surface of the thin film of the field between said holes which are adjoining two concerned being 20nm or less.

[0037] (23) In the thin film for information record of a publication, the sludge with which the melting point consists of a high high-melting component relatively from the residual element of the thin film concerned is included in either [said] 2, 5 and 6, and it is characterized by the melting point of the residual element of the thin film concerned being below 650-degreeC.

[0038] (24) In the thin film for information record of a publication, the sludge with which the melting point consists of a high high-melting component relatively from the residual element of the thin film concerned is included in either [said] 2, 5 and 6, and it is characterized by the melting point of the residual element of the thin film concerned being below 250-degreeC.

[0039] (25) The sludge with which the melting point consists of a high high-melting component relatively from the residual element of the thin film concerned in the thin film for information record of a publication is included in either [said] 2, 5 and 6, and either [at least] real part of the complex index of refraction of the thin film concerned or imaginary part is characterized by changing with the exposures of light 20% or more to it before an exposure.

[0040] (26) It is characterized by to be distributed in the field where the sludge with which the melting point consists of a high high-melting component relatively from the residual element of the thin film concerned is included in the thin film for information record which records and reproduces information, and the sludge consists of a residual element of the thin film concerned by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam.

[0041] (27) In the thin film for information record given in said 26, it is characterized by the dimensions

outside max in the direction of a film surface of the thin film of the sludge of said high-melting component concerned being 5nm or more and 50nm or less.

[0042] (28) In the thin film for information record given in said 26, the sludge of said high-melting component is prolonged in the shape of a column in the direction of thickness from the interface of both thin films concerned, and thickness lay length of said sludge is characterized by being the following (1/2) of the thickness of the thin film concerned by 5nm or more.

[0043] (29) In the thin film for information record given in said 26, the sludge of said high-melting component is prolonged in the shape of a column in the direction of thickness from one interface of the thin film concerned, and thickness lay length of said sludge is characterized by being below the thickness of the thin film concerned by 10nm or more.

[0044] (30) In the thin film for information record given in said 26, thickness lay length of the sludge of said high-melting component is characterized by being below the thickness of the thin film concerned by 10nm or more.

[0045] (31) It is characterized by the die length to which the straight line which connects the center to center of the sludge of said two high-melting components which adjoins said 26 in the thin film for information record of a publication passes along the field between these sludges by the direction of a film surface of the thin film concerned being 15nm or more and 70nm or less.

[0046] (32) The thin film for information record characterized by to include the porous sludge with which the melting point consists of a high high-melting component relatively from the residual element of the thin film concerned in the thin film for information record which records and reproduces information, and to be distributed the residual element of the thin film concerned in the hole of said porosity sludge by atomic-arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam.

[0047] (33) It is characterized by the maximum wall thickness in the direction of a film surface of the thin film of the field between said holes which are two which the maximum inside dimension method in the direction of a film surface of the thin film of the hole of the porosity-like sludge of said high-melting component concerned is 80nm or less, and adjoins said 32 in the thin film for information record of a publication concerned being 20nm or less.

[0048] (34) In the thin film for information record given in said 26 or 32, it is characterized by the melting point of the residual element of the thin film concerned being below 650-degreeC.

[0049] (35) In the thin film for information record given in said 32 or 32, it is characterized by the melting point of the residual element of the thin film concerned being below 250-degreeC.

[0050] (36) It is characterized by either [at least] the real part of the complex index of refraction of the thin film concerned or imaginary part changing with the exposures of light 20% or more to it before an exposure in the thin film for information record of a publication to either [said] 26 or 32.

[0051] (37) It is characterized by the sum of the atomic number of the configuration element of said high-melting component being in either [said] 26 or 32 in 10 - 50% of range to the sum of all the atomic numbers of the thin film concerned in the thin film for information record of a publication.

[0052] (38) Set to the thin film for information record given in either [said] 26 or 32, and it is $LjHk$ about an average presentation by the high-melting component H of an element simple substance, the low-melt point point component L of a compound presentation and an element simple substance, or a compound presentation. (6)

the time of expressing with a ** type -- 20 $\leq k/(j+K) \leq 40$ (7) it is -- a presentation is considered as a criteria presentation and it is characterized by the content in the inside of the film of each element being within the limits of value**10 atom % decided by said formula.

[0053] (39) In the thin film for information record given in either [said] 26 or 32, it is characterized by the melting point of said high-melting component being more than 780-degreeC.

[0054] (40) In the thin film for information record given in either [said] 26 or 32, it is characterized by the difference of the melting point of said high-melting component and the melting point of the residual element of the thin film concerned being more than 150-degreeC.

[0055] (41) In the thin film for information record of a publication, the sludge with which the melting point consists of a high high-melting component relatively from the residual element of the thin film concerned is included in either [said] 2, 5 and 6, it is desirable that the elements expressed with said B or said X are Mo, and Si, Pt, Co, Mn and W, and it is desirable that it is especially Cr.

[0056] (42) It is characterized by coming to have the process which forms a thin film through direct or a protective layer on a substrate in the manufacture approach of the thin film for information record which records and reproduces information by atomic-arrangement change which was formed through direct or a

protective layer on the substrate, and which is produced in response to the exposure of a energy beam, and the process which a energy beam irradiates [process], and generate or grow up a high-melting component into said thin film into said thin film.

[0057] (43) In the manufacture approach of the thin film for information record which records and reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam The process which is made to put the ingredient which has the presentation near the presentation of the ingredient of a high-melting component, or a high-melting component through direct or a protective layer on a substrate, and forms island-shape seed crystal, While making the ingredient containing said high-melting component and said residual element put on said seed crystal and growing up said high-melting component on said seed crystal alternatively, it is characterized by coming to have the process into which said residual element is grown up so that between these seed crystal may be filled.

[0058] The average thickness of the film for forming said island-shape seed crystal has 1nm or more and desirable 10nm or less. If the effectiveness of growing up a high-melting component as it is less than 1nm is small and exceeds 10nm, it will become the cause of noise increase.

[0059] By this approach, a high-melting component tends to grow toward that interior from the interface of one side of the thin film for information record.

[0060] It is desirable to use sputtering, although well-known approaches, such as vacuum deposition, vacuum evaporation among gas, sputtering, ion beam vacuum evaporation, ion plating, and electron beam evaporation, can be used for forming membranes by the manufacture approach of said 1st and 2nd thin films for information record.

[0061] In the case of sputtering, by the approach of carrying out a spatter with the target of a presentation of the thin film for record, the homogeneity in the inside of the film can improve a noise low. It is effective in being able to bring a deposit of a high-melting component forward and on the other hand, extending a rewritable count by the rotation coincidence spatter by the target of a presentation of a high-melting component, and the target of a presentation of a residual element.

[0062] (44) It is characterized by to have the process which changes the content of a high-melting component in the direction of thickness at the time of formation of the film which consists of a phase change component and a high-melting component through direct or a protective layer in the manufacture approach of the thin film for information record which records or reproduces information on a substrate by atomic-arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam.

[0063] (45) It is characterized by being the information record medium which equipped said 1-6, or 26 and 32 with the thin film for information record of a publication as a recording layer.

[0064] (46) It is characterized by being the information record medium which equipped said 1-6, or 26 and 32 with the thin film for information record of a publication as a mask layer for super resolution read-out.

[0065] (47) It is characterized by being the information record medium which equipped said 1-6, or 26 and 32 with the thin film for information record of a publication as a reflecting layer for super resolution read-out.

[0066] (48) The melting point of said residual element after a deposit of said high-melting component is characterized by being said 1-6, and the information record medium which equipped either 26 and 32 with the information record medium of a publication which is below 650-degreeC.

[0067] (49) In the information record medium which equipped said 1-6, any 47 of 26 and 32, or 48 with the thin film for information record of a publication as a reflecting layer for super resolution read-out, it is characterized by the reflection factor of said reflecting layer being 60% or more.

[0068] (50) In the information record medium which records or reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam Said 1-6, or 26 and 32 are equipped with the thin film for information record of a publication as a recording layer or a mask layer for super resolution read-out, and it is SiO₂ to a reflecting layer side. It is ZnS-SiO₂ to a layer and record film side. It is characterized by having the interlayer of the two-layer structure of a layer.

[0069] (51) In the information record medium which records or reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam It has the thin film for information record which records or reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam as a recording layer or a mask layer for super resolution read-out. And it is characterized by having the reflecting layer which is the presentation near at least one of Si-Sn, Si-germanium, and the Si-In compounds, or this.

[0070] (52) In the information record medium which records or reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam It has the thin film for information record which records or reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam as a recording layer or a mask layer for super resolution read-out. And the thickness of a reflecting layer has the 150nm or more description which is 300nm or less.

[0071] (53) In the information record medium which records or reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam It has the thin film for information record which records or reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam as a recording layer or a mask layer for super resolution read-out. And it is characterized by having the protective layer of ZnS-SiO two-layer two-layer structure at a SiO two-layer and record film side at an optical incidence side.

[0072] (54) The ingredient of a protective layer 2 and an interlayer 4 ZnS-SiO₂, a Si-N system ingredient, a Si-O-N system ingredient, SiO₂, SiO and Ta 2O₅, TiO₂ and aluminum 2O₃, Y2O₃, CeO and La 2O₃, In2O₃, GeO, GeO₂, PbO, SnO, SnO₂ and Bi 2O₃, TeO₂WO₂, WO₃, Sc 2O₃, Nitrides, such as oxides, such as ZrO₂, TaN and AlN, Si₃N₄, and an aluminum-Si-N system ingredient (for example, AlSiN₂), Sulfides, such as ZnS, Sb₂S₃, CdS, In₂S₃, Ga₂S₃, GeS, SnS₂ and PbS, and Bi₂S₃, Selenides, such as SnSe₂, Sb₂Se₃, CdSe, ZnSe, In₂Se₃, Ga₂Se₃, GeSe, GeSe₂, SnSe, PbSe, and Bi₂Se₃, It is desirable to use fluorides, such as CeF₃, MgF₂, and CaF₂, or Si, germanium and TiB₂, B4 C, B, and C, or the thing of the presentation near the above-mentioned ingredient. Moreover, the layers and these multiplex layers of these charges of an admixture are sufficient.

[0073] the case of a multiplex layer -- ZnS -- more than 70 mol % -- the oxide of the included ingredient 2, for example, ZnS-SiO, Si and the ingredient which contains at least 1 person of the germanium more than 70 atom %, for example, Si, or Si, for example, the two-layer film with SiO₂, is desirable. In this case, in order to prevent a record sensibility fall, ZnS-SiO two-layer is prepared in a record film side, and that thickness is set to 3nm or more. Moreover, in order to demonstrate the record membrane flow depressor effect by the SiO two-layer low-temperature expansion coefficient, 10nm or less in thickness is desirable. Although this two-layer film is desirable when it is prepared instead of a protective layer 2, you may prepare instead of an interlayer 4. As a substitute of a protective layer 2, the SiO two-layer thickness of 50nm or more 250nm or less is desirable. When preparing the two-layer film instead of an interlayer, SiO two-layer thickness has 10nm or more desirable 80nm or less. It is desirable to prepare these two-layer film, not only when using the record film of this invention but when using other phase change record film.

[0074] When an interlayer's 4 refractive index is in 1.7 or more and 2.3 or less range, 3nm or more, 100nm or less and 180nm or more, and 400nm or less have desirable thickness.

[0075] As an ingredient of a reflecting layer 5, since aluminum-Ti and the charge of a Si-germanium admixture can make the rate of light absorption of a record mark part smaller than the rate of light absorption of parts other than a record mark, it is based on an optical absorption coefficient difference, and disappears, the remainder can be prevented, and a rewritable count does not fall further, but it is desirable. More than 10 atom %, it is hard to produce a fall and the rewritable count of below 80 atom % is [the content of germanium] desirable.

[0076] Subsequently, the same result is obtained and two or more sorts of charges of an admixture of Si-Sn, the charge of a Si-In admixture, or the charge of these admixtures are also desirable. Even if it uses as a reflecting layer ingredient in the case of using not only the phase change film of this invention but other phase change film, since a rewritable count does not fall, these reflecting layer ingredients are desirable compared with the conventional thing.

[0077] Furthermore, the element simple substance of Si, germanium, C, Au, Ag, Cu, aluminum, nickel, Fe, Co, Cr, Ti, Pd, Pt, W, Ta, Mo, and Sb, Or the layer which consists of an alloy which makes these a principal component, or these comrades' alloy may be used, the multiplex layer which consists of those layers may be used, and the compound layer of these and other matter, such as an oxide, etc. may be used.

[0078] In this example, directly, although the polycarbonate substrate 1 in which the irregularity of a tracking guide etc. was formed is used for the front face instead, the chemically strengthened glass in which polyolefine, epoxy, acrylic resin, and a UV-cured resin layer were formed on the front face etc. may be used for it.

[0079] Even if it rewrites many times compared with the conventional thing, there are few noise rises, a good result is obtained and the configuration of the simple laminated structure 3 which omitted a part of interlayer

4, reflecting layer 5, and protective layer 2, for example, the 2/record film of 1/protective layers of substrates, the 3/interlayer 4 of 1/record film of substrates, the 3/reflecting layer 5 of 1/record film of substrates, etc. is also desirable.

[0080] As stated above, many rewritings are more possible for the thin film for information record of this example than before, keeping good record and playback / elimination property. Moreover, there is also an advantage that the power of the laser beam used for record and elimination may be low.

[0081] (55) The thin film for super resolution read-out of this invention which produces the super resolution effectiveness in response to the exposure of the beam for super resolution read-out is characterized by including a phase change component and the high-melting component which deposited. The thin film for super resolution read-out is formed through the protective layer which consists of at least 1 person among direct or an inorganic substance, and the organic substance on a substrate.

[0082] (56) The high-melting component with the high melting point deposits as pillar-shaped, a massive sludge, or a porosity-like sludge more relatively than a phase change component.

[0083] (57) The average presentation of the thin film for super resolution read-out shall be expressed with the following general formula.

[0084] DeEfFg (8)

At least one element with which said E was chosen from Sn, Pb, Bi, Zn, Ga, and In here, Said E As, B, C, N, O, S, Se, Si, Te, Ag, aluminum, Au, Ba, Be, calcium, Cd, Co, Cr, Cs, Cu, Fe, germanium, Hf, Hg, Ir, K, Li, Mg, Mn, Mo, Na, Nb, nickel, Os, Pd, Pt, Rb, Re, Rh, Ru, Sb, Said F can express at least one element except being expressed with said D and said E by expressing at least one element chosen from the group which consists of Sc, Sr, Ta, Ti, V, W, Y, and Zr, for example, it can be referred to as Tl, Br, Cl, F, H, I, P, etc. Moreover, said each of units of e, f, and g is atomic ratios, and it is desirable that it is in the range of $30 \leq e \leq 95$, $5 \leq f \leq 50$, and $0 \leq g \leq 20$, respectively. Furthermore, it is more desirable that it is in the range of $40 \leq e \leq 87$, $13 \leq f \leq 40$, and $0 \leq g \leq 10$.

[0085] The elements expressed with said F should just be elements other than Sn and Te, if the elements expressed with said D and E are Sn and Te for example, respectively. moreover, the combination of said D, D' (in the case [Said D is D and D' like Above Sn and Zn.] of two elements), and E and F -- setting -- D-E, E-F, and D' -- or the high-melting component made from the combination of -E does not have the eutectic point -- the eutectic point -- **** -- even if it is, it is desirable that 150-degree-C or more melting point is higher than the melting point of D and D'.

[0086] (58) What an average presentation is expressed with the following general formula to can be used for the thin film for super resolution read-out again.

[0087] SepMqNrOs (11)

At least one element with which said M was chosen from In, Sb, Bi, Te, Au, B, Cs, Sn, Tl, S, germanium, Fe, and Zn here, Said N As, C, N, O, Si, Ag, aluminum, Ba, Be, calcium, Cd, Co, Cr, Cu, Hf, Hg, Ir, K, Li, Mg, Mn, Mo, Na, Nb, nickel, Os, Pd, Pt, Rb, Re, Rh, Ru, Sc, Sr, Ta, Ti, V, W, Y, Zr, Pb, At least one element other than the element expressed with Ga, U, Se, and said M is expressed. Said O can express at least one element except being expressed with Se, said M, and said N, for example, can be set to Br, Cl, F, H, I, and P.

Moreover, they is atomic ratios, as for said each of units of p, q, r, and s, it is desirable that it is in the range of $40 \leq p \leq 95$, $0 \leq q \leq 55$, $5 \leq r \leq 50$, and $0 \leq s \leq 20$, respectively, and it is more desirable that it is in the range of $50 \leq p \leq 80$, $0 \leq q \leq 40$, $10 \leq r \leq 40$, and $0 \leq s \leq 10$.

[0088] (59) It is LjHk when the average presentation of the thin film for super resolution read-out is expressed with a degree type from the high-melting component H of an element simple substance, the low-melt point point component L of a compound presentation and an element simple substance, or a compound presentation. (6)

It is desirable that it is within the limits of value**10 atom % decided by the formula (7), and when the content in the inside of the film of each element which considers the presentation of the range of a bottom type (7) as a criteria presentation, and constitutes the above-mentioned thin film is within the limits of **5 atom %, it is more desirable.

[0089]

$20 \leq k/(j+k) \leq 40$ (7)

for example, the case where the criteria presentation of the film for super resolution read-out is 80 (GeSb2Te4) (Cr4Te5) 20 -- L of a formula (7) -- GeSb2Te4 and H -- Cr4Te5 it is -- $k/(j+k)$ is 20. It is here and, for Sb, Te is [atomic % of each element / germanium of L / Te of Cr of H] 11% 9% 46% 23% 11%, respectively. Then, for Sb, Te is [the range of value**10 atom % decided by the formula (7) / germanium of L / Te of Cr of H] 1 - 21% 0 to 19% 36 to 56% 13 to 33% 1 to 21%.

[0090] (60) As for each of low-melt point point components and high-melting components, it is desirable that

a metal or metalloid element is included more than 50 atom %, and containing more than 65 atom % is more desirable.

[0091] (61) The above-mentioned formula (8) and the presentation of (11) can be used also as phase change record film, and can be used also as phase change record film of the record medium which does not use a super resolution read-out thin film. When this record film is used, the big medium of a reflection factor difference can be produced by crystallization and amorphous-ization.

[0092] As for the sum of the atomic number of a high-melting component, it is desirable that it is 10 – 50% of range at a rate to the sum of all the atomic numbers of the configuration element of the super resolution read-out film, and it is more desirable that it is 20 – 40% of range.

[0093] (62) It is desirable that the element same in each component exists in the range below 80 atom % more than 30 atom % in the combination of a high-melting component and a phase change component.

[0094] As for the melting point of a high-melting component, it is desirable that it is higher than the melting point of the phase change component which is a residual element after a deposit 150 degrees C or more.

[0095] (63) The average presentation of a high-melting component can be used as the presentation near at least 1 person or this, or a compound with a melting point of 800 degrees C or more among the following A groups. Here, the presentation near this points out what has the enumerated gap from a presentation within the limits of **10 atom % (it is the same hereafter). for example, BaPd2 a case -- each element -- atomic % is [Pd of Ba] 67% 33%. then, presentation BaPd2 from -- as for Ba, a gap is [the range of Pd of **10 atom %] 57 – 77% 23 to 43%.

[0096] The <A groups> 2, NdPd3, NdPd5, Nd7Pt3, Nd3Pt2, NdPt, Nd3Pt4, NdPt2, NdPt5, Bi2Nd, BiNd, Bi3Nd4, Bi3Nd5, BiNd2, Cd2Nd, [BaPd, BaPd /5 /, and NdPd] CdNd, Mn2Nd, Mn23Nd6, Mn12Nd, Nd5Sb3, Nd4Sb3, NdSb, NdSb2, Fe2Nd, Fe17Nd2, Cs3germanium2, CsGe, CsGe4, Nd5Si3, Nd5Si4, NdSi, and Nd3Si4, Nd2 -- Si3 and Nd5 -- Si9 and Cs2 -- Te, NdTe3, Nd2Te5, NdTe2, Nd4Te7, Nd2Te3, Nd3Te4, NdTe, and Ce3 -- Ir, Ce2Ir, Ce55Ir45, CeIr2 and CeIr3, Ce2Ir7, and CeIr5 -- CaPd, CaPd2, CaGe, and calcium2 -- germanium, GeNa3, GeNa, CaSi2, calcium2Si, CaSi, Se2Sr, Se3Sr2, SeSr, GeSr2, GeSr, germanium2Sr, SnSr, Sn3Sr5, SnSr2, and Ce -- 2 Ti Ce5Ti3, CeTi3, Ce3Ti5, CeTi, BaTi, Pd13Ti9, and Pd2 -- Ti and Pd3 -- Ti and Mg2 -- Si and Mg2 -- germanium, BaPd2, BaPd5, Ce4Se7, Ce3Se4, Ce2Se3, CeSe, and Ce5germanium3 -- Ce4germanium3, Ce5germanium4, CeGe, Ce3germanium5, Ce5Si3, Ce3Si2, Ce5Si4, CeSi, Ce3Si5, CeSi2 and CeTe3, Ce2Te5, CeTe2, Ce4Te7, Ce3Te4, CeTe, La3Se7, LaSe2, La4Se7, La2Se3, La3Se4, LaSe, GeLa3, germanium3La5, germanium3La4, germanium4La5, GeLa, germanium5La3, BaSe2, Ba2Se3, BaSe, PdSe, and Mo3Se4, MoSe2 and Ba2 -- germanium, BaGe2, BaGe, Ba2Te3, BaTe, and germanium2 -- Pd5, GePd2, germanium9Pd25, GePd, germanium3Pt, germanium3Pt2, GePt, germanium2Pt3, GePt2, GePt3, Pu3Sn, and Pu5Sn3 -- Pu5Sn4, Pu8Sn7, Pu7Sn8, PuSn2, PuSn3, Pt5Te4, Pt4Te5, PtTe2, GeNi, germanium3nickel5, germanium2nickel5, GeNi3, NiTe 0.85, NiTe0.775, and nickel3**xTex, Cr11germanium19, CrGe, Cr11germanium8, Cr5germanium3, and Cr3 -- germanium, CrSi2, Cr5Si3, Cr3Si, Cr5Te8, Cr4Te5, Cr3Te4, Cr1-xTe, germanium3Mn5, GeMn2, Mn6Si, and Mn9Si2 -- Mn3Si, Mn5Si2, Mn5Si3, MnSi, Mn11Si19, Mn2Sn, Mn3.25Sn, MnTe, Te2W, FeGe2, Fe5germanium3, Fe3germanium, Fe2Si, Fe5Si3, FeSi, FeSi2, germanium2Mo, germanium41Mo23, germanium16Mo9, germanium23Mo13, germanium3Mo5, GeMo3, Mo3Si, Mo5Si3, MoSi2, MoSn, MoSn2, and Mo3 -- Te4, MoTe2, Si2Ti, SiTi, Si4Ti5, Si3Ti5, and SiTi3 -- Sn5Ti6, Sn3Ti5, SnTi2, SnTi3, CoGe2, Co5germanium7, CoGe, Co5germanium3, Co4germanium, Co3Te4, germanium7Re3, Re5Si3, ReSi, ReSi2, Re2Te.

[0097] (64) the average presentation of a high-melting component -- moreover, the compound mentioned to said A group and the following B group and ** -- it can consider as the presentation near at least 1 person or this, or a compound with a melting point of 600 degrees C or more inside.

[0098] the <B group> Cs 3 -- germanium and Ba2 -- Ti, GePd3, Fe6germanium5, FeTe2, Co5germanium2, Nd3Pd, Cs3Te2, Ce4Ir, NaPd, calcium9Pd, calcium3Pd2, and calcium2 -- germanium and Se3 -- Sr and Ce3 -- Ti, CeSe2, and Ce -- 3 germanium BaSe3, GeSe2, GeSe, BaTe2, GePd5, and germanium8 -- Mn11, MnTe2, germanium3W2, FeGe, Fe4germanium3, Fe3Sn, Fe3Sn2, FeSn, and CoTe2.

[0099] (65) the average presentation of a high-melting component -- moreover, the compound mentioned to said B group and following C group and ** -- it can consider as at least 1 person, the presentation near this, or a compound with a melting point of 400 degrees C or more inside.

[0100] <C group> Ba4Ti, CsTe, Ba4Ti, Ba13Ti, Cd11Nd, Cd6Nd, Cs5Te4, calcium3Pd, calcium5Pd2, Sn3Sr, Ba13Ti, PdTi2 and FeSe2, FeSe, Cr2Te3, CrTe3, and FeSn2.

[0101] (66) When using what was mentioned to said A group as a high-melting component, as for the average presentation of a phase change component, it is desirable that they are the presentation near at least 1 person or this or a compound with a melting point of 650 degrees C or less among the presentations of following D group.

[0102] <D group> Sn, Pb, Sb, Te, Zn, Cd, Se, In, Ga, S, Tl, Mg, Tl2Se, TlSe, Tl2Se3, Tl3Te2, TlTe, InBi, In2Bi, TeBi, Tl-Se, Tl-Te, Pb-Sn, Bi-Sn, Se-Te, S-Se, Bi-Ga, Sn-Zn, Ga-Sn, Ga-In, and In3SeTe2, AgInTe2, GeSb4Te7, germanium2Sb2Te5, GeSb2Te4, GeBi4Te7, GeBi2Te4, germanium3Bi2Te6, Sn2Sb6Se11, Sn2Sb2Se5, SnSb2Te4, and Pb2Sb6 -- Te11, CuAsSe2, Cu3AsSe3, CuSbS2, CuSbSe2, InSe, Sb2Se3, Sb2Te3, Bi2Te3, SnSb, FeTe, and Fe2Te3 -- FeTe2, ZnSb, Zn3Sb2, VTe2, V5Te8, AgIn2, BiSe, InSb, In2Te, In2Te5, Ba4Tl, Cd11Nd, Ba13Tl, Cd6Nd, Ba2Tl.

[0103] (67) When using what was mentioned to said B group as a high-melting component, as for the average presentation of a phase change component, it is desirable that they are the presentation near at least 1 person or this or a compound with a melting point of 450 degrees C or less among the presentations of following E group.

[0104] <E group> Sn, Pb, Te, Zn, Cd, Se, In, Ga, S, Tl, and Tl2Se, TlSe, Tl2Se3, Tl3Te2, TlTe, InBi, In2Bi, TeBi, Tl-Se, Tl-Te, Pb-Sn, Bi-Sn, Se-Te, S-Se, Bi-Ga, Sn-Zn, Ga-Sn, Ga-In, Ba4Tl.

[0105] (68) When using what was mentioned to said C group as a high-melting component, as for the average presentation of a phase change component, it is desirable that they are the presentation near at least 1 person or this or a compound with a melting point of 250 degrees C or less among the presentations of following F group.

[0106] <F group> Sn, Se, In, Ga, S, InBi, In2Bi, TeBi, Tl-Se, Tl-Te, Pb-Sn, Bi-Sn, Se-Te, S-Se, Bi-Ga, Sn-Zn, Ga-Sn, Ga-In.

[0107] (69) As for a presentation or thickness of the thin film for super resolution read-out, differing in inner circumference and a periphery is desirable, and it is desirable to also crystallize the truck periphery of the thin film for super resolution read-out. The thin film for super resolution read-out by this invention is applicable to any information record medium of the RAM disk which can record the ROM disk and information that information was already recorded.

[0108] (70) As for the whole film, it is desirable for presetting to be made the super resolution read-out power at which a high-melting component stops at solid phase without dissolving, or to have hand control or a means to set up automatically also in the field in which the equipment for super resolution read-out of an information record medium equipped with the thin film for super resolution read-out by this invention serves as a maximum temperature of the thin film for super resolution read-out. Moreover, it is desirable to have a means to detect turbulence of the reflected light intensity distribution at the time of super resolution read-out, and a means to adjust laser power according to the above-mentioned scale of turbulence. Moreover, it is desirable to have the means which enlarges laser power at the time of super resolution read-out more than twice as compared with power required for an automatic focus or tracking, and it is more desirable to have the means enlarged 3 or more times. Even if it uses this equipment for media other than this invention, a result better than the case of super resolution read-out laser power regularity is obtained.

[0109] (71) It is desirable that a super resolution read-out laser beam considers as pulsed light, and the period T of a laser pulse, linear velocity v, the diameter of a spot (λ/NA), and pulse width x fill following (9) and the relation of (10). $0.4 \lambda/NA \leq vT \leq 1.5 \lambda/NA$ (9)

$0.3 \leq x/T \leq 0.5$ (10)

It is more desirable to fill following (12) and the relation of (10) furthermore.

[0110]

$0.5 \lambda/NA \leq vT \leq 0.9 \lambda/NA$ (12)

(72) In the thin film for information record which records and reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam By repeating a laser beam and irradiating it with the informational record regenerative apparatus or the equipment for initial crystallization of a medium using the medium for information record which has the thin film concerned A high-melting component with the high melting point deposits more relatively than the residual element of the thin film concerned, and it has the description distributed in the field where the sludge consists of a residual element of the thin film concerned.

[0111] (73) Were formed through direct or a protective layer on the substrate. By repeating a laser beam and irradiating it in the informational record playback approach or the approach for initial crystallization of a medium using the medium for information record which has the thin film for information record which records and reproduces information, by atomic arrangement change produced in response to the exposure of a energy beam A high-melting component with the high melting point deposits more relatively than the residual element of the thin film concerned, and it has the description distributed in the field where the sludge consists of a residual element of the thin film concerned.

[0112] In the thin film for information record given in (74) and (1) to (6), by repeating a laser beam and irradiating it in the informational record regenerative apparatus or the equipment for initial crystallization of a

medium using the medium for information record which has the thin film concerned A high-melting component with the high melting point deposits more relatively than the residual element of the thin film concerned, it is distributed in the field where the sludge consists of a residual element of the thin film concerned, and the sludge is characterized by including the element expressed with either [said / at least] B or X.

[0113] (75) It is the manufacture approach of the medium for information record which records and reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam. The process which forms a protective layer, record film or the super resolution readout film, an interlayer, and a reflecting layer on a substrate, It is characterized by coming to have the process which a energy beam is irradiated [process], and generates or grows up a high-melting component into the process which sticks on this another substrate or another substrate which formed said each class similarly, and said medium into said thin film.

[0114] (76) It is the manufacture approach of the medium for information record which records and reproduces information by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam. The process which is made to put an ingredient with the presentation near the presentation of the ingredient of the process which forms a protective layer on a substrate, and a high-melting component, or a high-melting component, and forms island-shape seed crystal, While making the ingredient containing said high-melting component and said residual element put on said seed crystal and growing up said high-melting component on said seed crystal alternatively It is characterized by coming to have with the process into which said residual element is grown up so that between these seed crystal may be filled, the process which forms an interlayer and a reflecting layer, and the process which sticks on this another substrate or another substrate which formed said each class similarly.

[0115] (77) The process which is the manufacture approach of the medium for information record which records or reproduces information, and forms a protective layer on a substrate by atomic arrangement change which was formed through direct or a protective layer on the substrate, and which is produced in response to the exposure of a energy beam, It is characterized by having the process which changes the content of a high-melting component in the direction of thickness, forming the film which consists of a phase change component and a high-melting component, the process which forms an interlayer and a reflecting layer, and the process which sticks on this another substrate or another substrate which formed said each class similarly.

[0116] As said high-melting component, (78) For example LaTe3, LaTe2, La2Te3, La3Te4, LaTe, La2Te5, La4Te7, La3Te, La2Sb, La3Sb2, LaSb, LaSb2, La3germanium, La5germanium3, La4germanium3, La5germanium4, LaGe, La3germanium5, Ag2Te, Cr3Te4, Cr5Te8, Cr2Te3, Cr4Te5, CrSb, Cr3germanium, Cr5germanium3, Cr11germanium8, CrGe, and Cr11 -- germanium19, PtTe2, Pt4Te5, Pt5Te4, Pt4Sb, Pt3Sb2, PtSb, and Pt3 -- germanium and Pt -- 2 germanium Pt3germanium2, PtGe, and Pt2 -- germanium3, PtGe3, NiTe, NiTe 0.85, NiSb, nickel3germanium, nickel5germanium2, nickel5germanium3, NiGe, CoTe, CoTe2, Co3Te4, CoSb, CoSb2 and CoSb3, Co5germanium2, and Co5germanium3 -- CoGe and Co5 -- germanium7, CoGe2, Si2Te3, SiSb, SiGe, CeTe, Ce3Te4, Ce2Te3, Ce4Te7, CeTe2 and CeTe3, Ce2Sb, Ce5Sb3, Ce4Sb5, CeSb, CeSb2, Ce3germanium, and Ce5germanium3 -- Ce4germanium3, Ce5germanium4, CeGe, Ce3germanium5, Ce5Si3, Ce3Si2, Ce5Si4, CeSi, and Ce3 -- Si5, CeSi2, Cr3Si, Cr5Si3, CrSi, CrSi3 and CrSi2, Co3Si, CoSi, and CoSi2 and NiSi2 -- NiSi, nickel3Si2, nickel2Si, nickel5Si2, nickel3Si, Pt5Si2, Pt2Si, PtSi, LaSi2, Ag3In, Ag2In, Bi2Ce, BiCe, and Bi3 -- Ce4 and Bi3 -- Ce5, BiCe2, Cd11Ce, Cd6Ce, and Cd58Ce13 -- Cd3Ce, Cd2Ce, CdCe, Ce3In, Ce2In, Ce1+xIn, Ce3In5, CeIn2 and CeIn3, Ce2Pb, CePb, CePb3, Ce3Sn, Ce5Sn3, Ce5Sn4, Ce11Sn10, Ce3Sn5, Ce3Sn7, Ce2 -- Sn5, CeSn3, CeZn, CeZn2 and CeZn3, Ce3Zn11, Ce13Zn58, and CeZn5 and Ce3 -- Zn22 and Ce2 -- Zn17, CeZn11, Cd21Co5, CoGa, CoGa3, CoSn, Cr3Ga, CrGa, and Cr5Ga6 -- CrGa4 and Cu9 -- Ga4, Cu3Sn, Cu3Zn, Bi2La, BiLa, Bi3La4, Bi3La5, and BiLa2 and Cd11 -- La and Cd17 -- La2, Cd9La2, Cd2La, CdLa, Ga6La, Ga2La, GaLa, and Ga3 -- La5 and GaLa3 -- In3La, In2La, In5La3, InxLa, InLa, InLa2 and InLa3, La5Pb3, La4Pb3, La11Pb10, La3Pb4, La5Pb4, LaPb2 and LaPb3, LaZn, LaZn2, LaZn4, LaZn5, La3Zn22, La2Zn17, LaZn11 and LaZn13, NiBi, Ga3nickel2, GaNi, and Ga2 -- nickel3 and Ga3 -- nickel5, GaNi3, nickel3Sn, nickel3Sn2, nickel3Sn4, NiZn, nickel5Zn21, PtBi, and PtBi2 and PtBi3 -- PtCd2, Pt2Cd9, Ga7Pt3, Ga2Pt, Ga3Pt2, GaPt, Ga3Pt5, GaPt2 and GaPt3, In7Pt3, In2Pt, In3Pt2, InPt, In5Pt6, In2Pt3, InPt2 and InPt3, Pt3Pb, PtPb, Pt2Pb3, Pt3Sn, PtSn, Pt2Sn3, PtSn2 and PtSn4, Pt3Zn, PtZn2 and AIS, aluminum2S3, BaS, BaC2 and CdS, Co4S3, Co9S8, CoS, CoO and Co 3O4, Co2O3, Cr2O3, Cr3O4, CrO, CrS, CrN, Cr2N, Cr23C6, Cr7C3, Cr3C2, Cu2S, Cu9S5, CuO, Cu2O, In4S5, In3 S4, La2S3, La 2O3, Mo2C, MoC, Mn23C6, Mn4C, Mn7C3, NiO, SiS2, SiO2, Si3N4, Cu2Te, CuTe, Cu3Sb, Mn2Sb,

MnTe, MnTe2, Mn5germanium3, Mn3.25germanium, Mn5germanium2, Mn3germanium2, germanium3W, Te2W, AlSb, aluminum2Te3, Fe2germanium, FeGe2 and FeSb2, Mo3Sb7, It ZnTe(s). Mo3 -- Te4, MoTe2, PbTe, and GePd2 and germanium2 -- Pd5 and germanium9 -- Pd25, GePd5, Pd3Sb, Pd5Sb3, PdSb, SnTe, Ti5germanium3, germanium31V17, germanium8V11, germanium3V5, GeV3, V5Te4, and V3Te4 -- High-melting compounds, such as Ag2Se, Cu2Se, aluminum2Se3, InAs, CoSe, Mn3In, nickel3In, NiIn, nickel2In3, nickel3In7, and PbSe, Or there is high-melting compounds of a presentation near these, such mixture, or a 3 yuan or more compound near these mixed presentations.

[0117] the inside of these -- LaSb, CrSb, CoSb, Cr3Te4, Cr2Te3, Cr4Te5, CoTe, and Co3 -- especially at least one of Te4, LaTe3, Cu2Te, CuTe, Cu3Sb, MnTe, MnTe2, and Mn2Sb(s) is desirable. Since the reason has a refractive index close to a residual element, it is in that it is hard to generate a noise the melting point being high.

[0118] As for the content of the oxide contained in said high-melting component, a sulfide, a nitride, and carbide, it is desirable to carry out to under 40 atom % of all the configuration atomic numbers of said high-melting component, and it is desirable especially to carry out to under 10 atom %. It is because the difference of the complex index of refraction of components other than the high-melting component of the thin film concerned, i.e., a residual element, cannot be made small as these contents are more than 40 atom %s, or it is easy to produce the problem which oxygen etc. is spread [problem] and degrades record and reproducing characteristics in the residual element concerned.

[0119] Since said thin film for information record performs informational record, playback, and elimination where the sludge of said high-melting component is distributed, it is desirable that it is a mixed presentation with said high-melting component and the component which carries out a phase change reversibly. Not only the phase change between crystallized state-amorphous states but the phase change between crystallized state-crystalline substance conditions is included with a "phase change" here.

[0120] Although the thing of arbitration can be used if it is an ingredient with a suitable phase change property besides a known phase change record ingredient as a component which carries out a phase change reversibly In the compound of a large number described above as an example of a high-melting component, the compound containing transition-metals elements, such as Cr, is desirable, and below 40 atom % of the total configuration atomic number of the thin film concerned of the content of the transition-metals element is desirable, and below its 34 atom % is more desirable. When this condition is fulfilled, there is an advantage that the effectiveness which makes small an interface reflection factor with the phase change component of the high-melting component which deposits, Te system, or Sb system becomes large.

[0121] As for the value of the real part n1 of the refractive index of said high-melting component, and imaginary part k1, it is desirable that it is [of the value of the real part n2 in the crystallized state of the viewpoint which prevents light scattering in the interface of said high-melting component and phase change component to said phase change component, and imaginary part k2] less than **40%, respectively, and it is more desirable that it is less than **20%.

[0122] It is desirable that 6% or less has the interface reflection factor as which the difference of k1 and k2 is less than **70%, and the difference of n1 and n2 is expressed in $|[(n_1+ik_1)-(n_2+ik_2)]/[(n_1+ik_1)+(n_2+ik_2)]|$ 2 less than **10%. Moreover, it is more desirable that less than **10% and the difference of k1 and k2 is [the difference of n1 and n2] less than **70%, and an interface reflection factor is 2% or less. It is desirable to fulfill these conditions, although thickness is thickened, regenerative-signal level is enlarged and light scattering in an interface is prevented.

[0123] the case where the phase change component of the range where the refractive index (n, k) of a high-melting component is desirable is a germanium-Sb-Te system -- $5.0 \leq n \leq 6.2$ $1.1 \leq k \leq 6.1$ it is -- the case where a phase change component is an In-Sb-Te system -- $1.5 \leq n \leq 1.8$ $0.6 \leq k \leq 3.6$ it is .

[0124] When a high-melting component cannot distinguish the sludge of a high-melting component clearly in said thin film for information record, it understands as follows. That is, 80% or more, if any one of the presentations of residual elements other than said high-melting component (for example, phase change component) is removed from the average presentation of the thin film concerned, when becoming a presentation at the high-melting component of the remainder with which 90% or more fills the conditions of the melting point of this invention, the high-melting component of this invention shall deposit more preferably.

[0125] Although the organic substance is sufficient as the "protective layer" used for protection of the thin film for information record and an inorganic substance is sufficient as it, its inorganic substance is more desirable in respect of thermal resistance. However, since a mechanical strength is increased, if the protective layer of the inorganic substance formed apart from the substrate is thickened, since it will be easy to produce crack initiation, a permeability fall, a sensibility fall, etc., while making this protective layer thin, it

is desirable to stick a thick organic layer to a concerned thin film [of this protective layer] for information record and opposite side. The layer formed apart from the substrate is sufficient as this organic layer, and the substrate of the organic substance is sufficient as it. Deformation stops being able to happen easily due to this.

[0126] The protective layer of the organic substance can be formed with fluororesins, such as acrylic resin, a polycarbonate, polyolefine, an epoxy resin, polyimide, a polyamide, polystyrene, polyethylene, polyethylene terephthalate, and Pori ethylene tetrafluoride (Teflon), etc. The ethylene-vinylacetate copolymer known as hot melt adhesive, a binder, etc. may be used. At least one of the resin of these may be formed with the ultraviolet-rays hardening resin used as a principal component. You may serve as a protective layer with the substrate of the organic substance.

[0127] The protective layer of an inorganic substance can be formed with the inorganic substance which uses an oxide, fluoride, a nitride, a sulfide, a selenide, carbide, a boride, boron, carbon, or a metal as a principal component. You may serve as a protective layer with the substrate of the inorganic substance which uses glass, a quartz, sapphire, iron, titanium, or aluminum as a principal component.

[0128] The oxide of at least one element chosen from the group which consists of Ce, La, Si, In, aluminum, germanium, Pb, Sn, Bi, Te, Ta, Sc, Y, Ti, Zr, V, Nb, Cr, and W as an example of the protective layer of an inorganic substance. The sulfide or selenide of at least one element chosen from the group which consists of Cd, Zn, Ga, In, Sb, germanium, Sn, and Pb, Nitrides, such as fluorides, such as Mg, Ce, and calcium, and Si, aluminum, Ta, B, It is what consists of boron or carbon. Or for example, a principal component CeO₂, La₂O₃, SiO, SiO₂ and In₂O₃, aluminum₂O₃, GeO, GeO₂, PbO, SnO, SnO₂ and Bi₂O₃, TeO₂, WO₂, WO₃ and Ta₂O₅, Sc₂O₃, Y₂O₃, TiO₂, ZrO₂, CdS and ZnS, CdSe, ZnSe, In₂S₃, In₂Se₃, Sb₂S₃, Sb₂Se₃, Ga₂S₃, Ga₂Se₃, MgF₂, CeF₃, CaF₂ and GeS, GeSe, GeSe₂, SnS and SnS₂, SnSe, SnSe₂ and PbS, PbSe, Bi₂Se₃, Bi₂S₃, TaN, Si₃N₄, Things with the presentation near one or it of AlN, AlSiN₂, Si, TiB₂, and B₄C, SiC, B, and C or those mixture exist.

[0129] The thing of the presentation near [in a sulfide] ZnS or it has [among these] a desirable refractive index in suitable magnitude at the point that the film is stable. In a nitride, the thing of the presentation near [in a point firm about the film being stable] TaN, Si₃N₄, AlSiN₂ or AlN (alumimium nitride), or it is desirable not much highly [a surface reflection factor]. In an oxide, the thing of the presentation near [in the point that the film is stable] Y₂O₃, Sc₂O₃, CeO₂, TiO₂, ZrO₂, SiO and Ta₂O₅, In₂O₃, aluminum₂O₃, SnO₂ or SiO₂, or them is desirable. Amorphous Si containing hydrogen is sufficient.

[0130] If said protective layer is made the multilayer configuration of two-layer [of an inorganic substance-inorganic substance or the inorganic substance-organic substance], or three layers or more, a protective effect will increase further.

[0131] Film formation is easy if mixture is used for said protective layer. For example, in 80 (ZnS) (SiO₂) 20 layer with a thickness of 50-500nm, a protective effect, record / elimination property, and a rewriting property are good, and membranous formation is also easy.

[0132] Said protective layer can also be formed with the composite material of the organic substance and an inorganic substance again.

[0133] Although you may form by electron beam evaporation, sputtering, etc. by presentation as it is, if it is made to make it react with at least one of oxygen, sulfur, and nitrogen after the protective layer of an inorganic substance forms the film with which reactive sputtering or a metal, semimetal, and the semiconductor of at least 1 yuan become from the first, it will become easy to form membranes it.

[0134] Generally, if light is irradiated at a thin film, interference will arise by the superposition of the reflected light from the front face of a thin film, and the reflected light from the rear face of a thin film. So, when reading a signal by change of the reflection factor of a thin film, by preparing the "reflecting layer" which approaches the thin film for record and reflects light, effectiveness of interference can be enlarged and a playback (read-out) signal can be enlarged by it. In addition, it is good also as an absorption layer which absorbs light.

[0135] In order to enlarge effectiveness of interference more, it is desirable to prepare an "interlayer" between the thin film for record and a reflecting layer. An interlayer has the operation which the recess of the operation which prevents that counter diffusion happens between the thin film for record and a reflecting layer, and the heat to a reflecting layer is decreased, and raises record sensibility at the time of rewriting, disappears and prevents the remainder.

[0136] If an interlayer's quality of the material is chosen suitably, a part of role [at least] of the thin film for information record can also be made to play. For example, if an interlayer is formed by the selenide, some [at least] elements of the thin film for record will be spread into an interlayer, it will react with the element in an interlayer, or some [at least] an interlayer's elements will be spread into the thin film for record, or a

reflecting layer, and it will come to play some roles of the thin film for record by it.

[0137] An interlayer's thickness is 3nm or more and 400nm or less, and making it near and the value become the neighborhood or more than it 20% in the condition of another side at the minimal value moreover has the desirable reflection factor of the thin film for record near the wavelength of read-out light in either a record condition and an elimination condition.

[0138] If the ingredient with which thermal conductivity uses the high temperature conductivity ingredients (for example, Au etc.) of 2.0 or more W/cm-deg as a principal component is used as a reflecting layer, a thermal diffusivity becomes high, and even if it uses the thin film for record crystallized at high speed, when a high-power laser beam is irradiated, it will come to make it amorphous certainly. In this case, it is desirable that use an ingredient with high thermal conductivity (for example, aluminum2 O3, AlN, Si3 ingredient of presentations near it, such as N4 and ZnS) also for an interlayer, or thermal conductivity, such as SiO2, especially makes an interlayer thin using the ingredient of whenever [middle] (0.02 or more W/cm-deg, 0.1 W/cm-deg or less). However, in order to raise record sensibility, it is desirable to form a reflecting layer with the ingredient of thermal conductivity lower than the aforementioned value.

[0139] A reflecting layer may be arranged to the substrate side of the thin film for information record, and may arrange to the opposite side with the substrate of the thin film for information record.

[0140] The interlayer of a reflecting layer is still more desirable if the protective layer (upper *****) which becomes from an usable inorganic substance at said protective layer is formed in an opposite side. In 3 lamination which consists of these interlayers, a reflecting layer, and a protective layer, it becomes firmer than the protective layer of a monolayer as a whole.

[0141] What is necessary is just to perform formation of said substrate, the thin film for record, a protective layer, the middle class, and a reflecting layer by selecting either suitably from approaches, such as vacuum deposition, vacuum evaporation among gas, sputtering, ion beam vacuum evaporation, ion plating, electron beam evaporation, injection molding, casting, rotation spreading, and a plasma polymerization.

[0142] As for all of said thin film for record, a protective layer, an interlayer, a reflecting layer, and the protective layer that adjoined the reflecting layer, forming by sputtering is most desirable.

[0143] The aforementioned thin film for information record is good also as a gestalt distributed by vapor codeposition, ** sputtering, etc. in carbon or carbide, such as an oxide mentioned above as an usable ingredient in protective coats, fluoride, a nitride, and the organic substance. By doing so, a light absorption multiplier may be able to be adjusted and regenerative-signal reinforcement may be able to be enlarged.

[0144] In this case, 40% or less has the desirable rate of the atomic number which oxygen, fluorine, nitrogen, and carbon have to the whole film in a thin film, and 20% or less of a mixed ratio is more desirable.

[0145] Although the rate of crystallization falls and sensibility usually falls by performing such bipolar membrane-ization, sensibility improves in bipolar membrane-ization with the organic substance.

[0146] Generally, when recording information by phase transition (phase change), it is desirable to crystallize the whole surface of record film beforehand, but a substrate cannot be made into an elevated temperature when the organic substance is used for the substrate. Then, it is necessary to make it crystallize by the other approach.

[0147] There is combination of the UV irradiation by an exposure, a xenon lamp, a mercury lamp, etc. of a laser beam which converged as a desirable method of crystallizing in this case, for example so that the diameter of a spot might be set to 2 micrometers or less, heating and the exposure of flash lamp light, the exposure of the light by the big laser beam spot from high power gas laser or about [output 1W] high power semiconductor laser, or heating and a laser beam exposure etc.

[0148] When irradiating the laser beam which converged the diameter of a spot to 2 micrometers or less at the thin film for information record, the exposure of multiple times is needed in many cases. For this reason, a thin film will be irradiated repeatedly and a single laser beam takes long duration. In order to avoid this, it is good to divide the beam of gas laser into plurality, using a semiconductor laser array, and to make it irradiate coincidence at two or more places. Thereby, many laser beam exposures only by rotating a thin film one time are attained.

[0149] Although each optical spot may be made to arrange in parallel on the same recording track, it may be made to arrange in parallel on two or the truck beyond it. It is still more desirable if it is made to irradiate between a truck top and a truck at coincidence. The laser beam power of each spot does not need to be the same.

[0150] It is efficient when irradiating the single beam from gas laser or high power semiconductor laser, and the diameter of a spot (it is a major axis in said location if it is a diameter in the location optical reinforcement (will become one half in) if it is an optical circular spot, and the optical spot of an ellipse form) sets to 5 micrometers or more and 5mm or less.

[0151] Crystallization is produced only on a recording track and it is good also as while it has been amorphous between trucks. Between recording tracks may be crystallized.

[0152] For example, when the thin film which uses Sb, Te, germanium, and Cr as a principal component is formed by the rotation vacuum evaporation from two or more evaporation sources, immediately after vacuum evaporation, the atom of Sb, Te, germanium, and Cr has not joined together well in many cases. Moreover, also when this thin film is formed by sputtering, it will be extremely confused by atomic arrangement. So, in such a case, while irradiating on a recording track, heating the laser beam of high power density first and depositing a high-melting component, it is good to dissolve a thin film alternatively depending on the case. Then, the laser beam of power density low on said recording track is irradiated, and said thin film is crystallized. When it carries out like this, there is an advantage from which a reflection factor tends to become homogeneity over the truck perimeter.

[0153] Although a high-melting component may not exist in the thin film for information record before irradiating energy beams, such as a laser beam, a high-melting component can be deposited or grown up into the thin film by the above crystallization processings. As the high-melting component which deposited or grew was mentioned above, it is mostly distributed independently granular or in the shape of a column in a thin film, or a high-melting component is continuously distributed in the shape of porosity. In the case of the former, a high-melting component is distributed in the residual element (usually phase change component) of the thin film concerned. In the case of the latter, a residual element is embedded into many holes of the sludge of a high-melting component.

[0154] By this 1st manufacture approach, a high-melting component tends to grow toward that interior from the interface of the both sides of the thin film for information record.

[0155] It is possible to record information by the laser beam which carried out the power modulation between the power level to crystalize and the power level changed into the condition near an amorphous substance (over-writing) regardless of the condition after crystallization of a thin film.

[0156] the 1- of this invention -- it is not necessary to necessarily use change between an amorphous state and a crystallized state for record, and the 6th thin film for information record is sufficient with a certain atomic arrangement change of [the membranous formation of a form status change / hardly], if change of optical property is made to cause. A flow and segregation of a thin film are certainly prevented by the sludge of said high-melting component.

[0157] For example, change of the diameter of crystal grain and crystal form, change between a crystal and metastable states (pi, gamma, etc.), etc. are sufficient. Change of an amorphous state and a crystallized state is sufficient, and it is also good to intermingle the part of both the conditions instead of a perfect amorphous substance or a crystallized state, and for those ratios to change.

[0158] Moreover, when the part of the atoms which constitute these layers moves by diffusion, a chemical reaction, etc. between the thin film for record, and at least 1 of a protective layer and interlayers, information may be recorded and information may be recorded by both migration of an atom and the phase change.

[0159] The 1st information record medium of this invention is characterized by having said the 1st -- the 6th one of thin films for information record as a recording layer.

[0160] As for one [at least] interface of said thin film for information record, having stuck to said protective layer is desirable. By the protective layer, the increment in a noise resulting from deformation of the thin film at the time of information rewriting can be prevented.

[0161] The 2nd information record medium of this invention is characterized by having either of said 1st and 6th thin films for information record as a mask layer for super resolution read-out.

[0162]

[Function] the 1- of this invention -- in the 4th thin film for information record, and the information record medium using it, since the element expressed with said B or X to Sb and Te is added, the sludge of the high-melting component which is not dissolved by the exposure of record / playback light, such as a laser beam, is generated inside. For this reason, even if residual elements other than a high-melting component dissolve by said light, a flow at the time of that flow and segregation being prevented effectively, consequently rewriting many times and a segregation are prevented effectively. Moreover, when the high-melting component which deposited is large to the thickness of the thin film for information record, in order to press down deformation by the thermal expansion of the protective layer with which the above-mentioned thin film is in contact, or an interlayer and to maintain spacing of a protective layer and an interlayer, the flow prevention effectiveness of the above-mentioned thin film becomes higher. For this reason, a carrier-to-noise ratio (C/N) is stabilized, and many rewritings or read-out become possible from the former, keeping record and reproducing characteristics good.

[0163] If the element further expressed with said A by the element expressed with Sb, Te, and said B or X

lives together, an amorphous state will be held at stability and, moreover, crystallization at the time of record and elimination will come to be performed at high speed. Moreover, a crystallization rate is controlled the optimal and a carrier-to-noise ratio and an elimination ratio improve.

[0164] In the 5th [of this invention], and 6th thin films for information record, and the information record medium using it, even if record / playback light, such as a laser beam, is irradiated, the sludge of the high-melting component contained inside is not dissolved. For this reason, even if residual elements other than a high-melting component dissolve by said light, that flow and segregation are prevented effectively.

Consequently, many rewritings or read-out become possible from the former, keeping record and reproducing characteristics good.

[0165] the 1st information record medium of this invention -- said the 1- since it has the 6th thin film for information record, many rewritings or read-out become possible from the former, keeping record and reproducing characteristics good.

[0166] the 2nd information record medium of this invention -- said the 1- if an optical spot is irradiated by the mask layer which consists of either of the 6th thin film for information record, in the elevated-temperature section in an optical spot, residual elements other than said high-melting component will dissolve at least. Since the real part or imaginary part (extinction coefficient) of a refractive index of the elevated-temperature section becomes smaller than that of the low-temperature section besides an optical spot, the mask of a part of field of the diameter of an optical spot is partially carried out by said mask layer, and the diameter of an optical spot came to have decreased. Consequently, a record mark smaller than the diameter of an optical spot can be read, namely, super resolution read-out becomes possible.

[0167] the 3rd information record medium of this invention -- said the 1- if an optical spot is irradiated by the reflecting layer which consists of either of the 6th thin film for information record, the real part or the extinction coefficient of a refractive index of the elevated-temperature section in the path of an optical spot will become smaller than that of the low-temperature section besides an optical spot. For this reason, sufficient contrast for reading of a record mark will not be given to the reflected light of the light irradiated by the elevated-temperature section of the reflecting layer concerned. Consequently, in order for the diameter of an optical spot to decrease, the record mark formed in the pitch smaller than the diameter of an optical spot can be read, namely, super resolution read-out becomes possible.

[0168] Moreover, since the high-melting component with the high melting point deposits more relatively than a phase change component, a flow at the time of the super resolution read-out film dissolving by laser radiation at the time of super resolution read-out and a segregation are prevented effectively. For this reason, it becomes possible from the former to perform many super resolution read-out, maintaining a good super resolution read-out property.

[0169] Since the element expressed with A in a formula dissolves the average presentation of the thin film for super resolution read-out at low temperature when expressed with said general formula (8), super resolution read-out becomes possible at low temperature, and optical disks other than the optical disk which recorded information in phase pits including a phase-change optical disk can also perform super resolution read-out. When the element expressed with said B to this lives together, the compound of said compound of D and E, the element of E, or the elements of E serves as a high-melting component, and it has the effectiveness of preventing a flow at the time of the super resolution read-out film dissolving, and a segregation. (12) C/N can be enlarged if TI is made to live together as F in a formula.

[0170] With the equipment for super resolution read-out of this invention, in order to enlarge laser power only at the time of super resolution read-out, degradation of the super resolution read-out film is prevented, and many super resolution read-out becomes possible. Moreover, when the period T of the laser at the time of super resolution read-out, linear velocity v, the diameter of a spot (λ/NA), and pulse width x fill the above (9) and the relation of (10), the mask area size at the time of super resolution read-out can be kept suitable, and a super resolution read-out property can be improved. Even if it uses this equipment for media other than this invention, a result better than the case of super resolution read-out laser power regularity is obtained.

[0171]

[Example] Hereafter, an example explains this invention to a detail.

[0172] [Example 1]

(A configuration and process) Drawing 3 shows the cross-section structure of a disk-like information record medium where the thin film for information record of the 1st example of this invention was used. This medium was manufactured as follows.

[0173] First, the polycarbonate substrate 1 which has the tracking slot of a cross-section U typeface was formed in the front face by 1.2mm in the diameter of 13cm, and thickness. Next, in order to form a thin film

one by one on this substrate 1, the substrate 1 was placed into the magnetron sputtering system. This equipment can have two or more targets, and can form a cascade screen one by one. Moreover, it excels in the homogeneity of membranous thickness and repeatability which are formed.

[0174] With the magnetron sputtering system, the protective layer 2 which consists of 80 (SiO₂) 20 film first (ZnS) on a substrate 1 was formed so that it might become about 125nm of thickness. Then, after forming in island shape Cr₄Te₅ film (not shown) which is a high-melting component to 3nm of average thickness on a protective layer 2, Sb₁₆Te₅₅germanium₁₆Cr₁₃₃, i.e., (germanium₂Sb₂Te₅) (7(Cr₄Te₅) 3), the record film of a presentation, was formed to about 30nm of thickness on it. Under the present circumstances, the rotation coincidence spatter by Cr₄Te₅ target and germanium₂Sb₂Te₅ target was used. The pitch of about 2-20nm and an island has [the size of island-shape Cr₄Te₅ film] desirable x (size) (1.5-10).

[0175] It is not necessary to necessarily form Cr₄Te₅ film. In that case, the high-melting component which deposits in record film 3 is produced in the case of initial crystallization mentioned later.

[0176] Next, after forming the interlayer 4 who consists of 80 (ZnS) (SiO₂) 20 film to about 25nm thickness on record film 3, the reflecting layer 5 which consists of aluminum₉₇Ti₃ film within the sputtering system same on it was formed to 80nm of thickness. In this way, the 1st disk member was obtained.

[0177] On the other hand, the 2nd disk member with the same configuration as the 1st disk member was completely obtained by the same approach. The laminating of the 2nd disk member was carried out to order with a diameter [of 13cm], and a thickness of 1.2mm on substrate 1'. Protective layer 2' which consists of 80 (ZnS) (SiO₂) 20 film of about 125nm of thickness, Sb₁₆Te₅₅germanium₁₆Cr₁₃ of Cr₄Te₅ film (not shown) of 3nm of average thickness, and about 30nm of thickness -- namely, (germanium₂Sb₂Te₅) (7(Cr₄Te₅) 3), record film 3' -- thickness -- about -- 25 -- nm -- 80 (ZnS) (SiO₂) -- 20 -- the film -- becoming -- an interlayer -- four -- ' -- and -- thickness -- 80 -- nm -- aluminum -- 97 -- Ti -- three -- the film -- becoming -- a reflecting layer -- five -- ' -- having -- ***.

[0178] Then, the disk-like information record medium which shows the reflecting layer 5 of said 1st and 2nd disk members and 5' to lamination and drawing 3 was obtained through the vinyl chloride-vinyl acetate system hot-melt-adhesive layer 6.

[0179] By this medium, when the whole surface of a reflecting layer 5 and 5' was pasted up, a rewritable count was able to be made [many] compared with the case where the whole surface is not pasted up and adhesives were not attached to a reflecting layer 5 and the part corresponding to the record section of 5', record sensibility became high for a while rather than the case where adhesives are attached also to that part.

[0180] (Initial crystallization) Initial crystallization was performed to the record film 3 of the medium which is the above, and was made and manufactured, and 3' as follows. In addition, since the same is completely said of record film 3', in the following explanation, it considers as what only record film 3 is described for.

[0181] The medium was rotated by 1800rpm, the laser beam power of semiconductor laser (wavelength of 830nm) was maintained at the level (about 1mW) on which record is not performed, and the numerical aperture in a recording head (NA) condensed with the lens of 0.55, and irradiated the laser beam through the substrate 1 at record film 3. The reflected light from record film 3 was detected, and while performing tracking so that the core of a laser beam spot might always be in agreement with the core of the tracking slot of a substrate 1, the recording head was driven, performing automatic-focusing doubling so that the focus of a laser beam may come on record film 3.

[0182] First, the continuation laser beam (power 12mW, 13mW, and 14mW) was irradiated 500 times on the same recording track of record film 5, respectively for initial crystallization. Finally, the power 15mW continuation (DC) laser beam was irradiated 1000 times. The irradiation time (optical spot pass time) of each time is about 0.1microsec.

[0183] Then, the power 8mW continuation laser beam was irradiated 500 times. The irradiation time (optical spot pass time) of each time is about 0.1microsec. What is necessary is for the range of the laser beam power at this time just to be 5-9mW.

[0184] The exposure with the lower power among said two kinds of laser beam exposures (8mW) may be omitted.

[0185] Thus, if the laser beam from which power differs is irradiated, initial crystallization can fully be performed.

[0186] It is still more desirable if it carries out using the thing which performed these laser beam exposures using the semiconductor laser array, or divided the light beam from gas laser into plurality, or the thing which made the spot configuration of the light beam from high power gas laser or semiconductor laser the ellipse long to radial [of a medium]. If it carries out like this, it will also become possible to complete initial crystallization only by carrying out a small number of rotation of the medium.

[0187] If these laser beam spot is not arranged on the same recording track, but a location little by little and it is arranged to it when using two or more laser beam spots, it will disappear [which can initialize the large range by one exposure], and effectiveness, like the remainder decreases will be acquired. [radial / of a medium]

[0188] next, the 12mW continuation laser beam (high-power light of record) of a circular spot is irradiated once -- every (irradiation time: about 0.1microsec) -- power 18mW pulsed laser light (high-power light for record) was irradiated, record film 5 was made amorphous, and the recording point was formed. Then, in order to irradiate a 8mW continuation laser beam (low power light for initial crystallization) and to crystallize the recording point, irradiating a 8mW continuation laser beam how many times investigated whether it was the need.

[0189] Consequently, the count of said 8mW continuation laser beam exposure which crystallization takes fell, so that the count of an exposure increased [the count of an exposure of a 12mW continuation laser beam] to 5 times. That is, it turned out that it is easy to crystallize, so that the count of an exposure increases. This is guessed because much detailed crystals of Cr4Te5 which is a high-melting component deposited in record film 5 and the presentation of germanium2Sb2Te5 which the presentation of the remainder (part which carries out a phase change) can crystallize [high-speed] was approached by the exposure of a 12mW continuation laser beam.

[0190] In addition, the melting point of Cr4Te5 is 1252-degreeC, and the melting point of germanium2Sb2Te5 is 630-degreeC.

[0191] (Record and elimination) Next, performing tracking and automatic-focusing doubling like the above, it was made to change to the record section of the record film 3 which initial crystallization completed as mentioned above according to the information signal which should record the power of the laser beam for record between middle power level (8mW) and high power level (18mW), and information was recorded on it. When the part which should be recorded was passed, it was made to lower laser beam power to the low power level (1mW) of the laser beam for playback (read-out). The part near the amorphous substance or it which is formed in a record section of the laser beam for record serves as a recording point.

[0192] Especially the power ratio of the high level of the laser beam for record and middle level has the desirable range of 1:0.3 to 1:0.8. Moreover, in addition to this, you may make it the power level of short-time every others.

[0193] By such record approach, if direct and new information is recorded to the part on which information is already recorded, it will be rewritten by new information. That is, over-writing by the single circular light spot is possible.

[0194] However, the continuation light of the power (for example, 9mW) near the middle power level (8mW) of the aforementioned laser beam for record which carried out the power modulation is irradiated by one rotation or two or more rotations of the beginning at the time of rewriting. The information currently recorded is once eliminated. By the following one rotation after that between the low power level (1mW) of the laser beam for playback (read-out), and the high power level (18mW) of the laser beam for record Or the laser beam which carried out the power modulation according to the information signal is irradiated, and you may make it record between the middle power level (8mW) of the laser beam for record, and high power level (18mW). Thus, if it is made to record after eliminating information, the information currently written before disappears, there will be little remainder and a high carrier-to-noise ratio (C/N) will be obtained.

[0195] Thus, when carrying out a rewrite after elimination, when the high level (18mW) of said laser beam for record is set to 1, it is desirable [the power level of a continuation laser beam irradiated first] to set it as the range of 0.4-1.1. It is because good rewriting can be performed if it is this range.

[0196] This approach is effective not only in the record film of this invention but other record film.

[0197] It was possible to have repeated record and elimination 105 times or more with the information record medium of this example on the severe conditions which made power of a laser beam higher 15% than an optimum value. Moreover, C/N of the regenerative signal when recording a 2MHz signal was about 50dB, and was very good.

[0198] With the record film 3 of this example, it is understood because a flow and segregation of the residual element (phase change part) of record film 3 are prevented by the high-melting component which deposited in record film 3 that a rewritable count can be made into 105 times or more.

[0199] In addition, when the interlayer 4 of ZnS-SiO₂ and the reflecting layer 5 of aluminum-Ti which were formed on record film 3 were omitted, some increments in a noise took place by record and elimination of a count also with few [a single figure] said twists.

[0200] In the record film 3 which consists of above 7(germanium2Sb2Te5) (Cr4Te5) 3 (Relation with the Te content y) The irradiation time of a laser beam required for elimination of the information which the Te

content y is changed keeping the relative ratio of other elements constant, and is recorded, Change of the carrier-to-noise ratio (C/N) of the regenerative signal after rewriting laser beam power 105 times on the severe conditions made higher 15% than an optimum value was measured. Consequently, the following data were obtained.

[0201]

消去に必要なレーザ光照射時間

y = 3 4	0. 5 μ sec
y = 4 0	0. 1 μ sec
y = 5 0	0. 1 μ sec
y = 6 0	0. 1 μ sec
y = 6 7	0. 5 μ sec
y = 7 0	1. 0 μ sec
y = 7 5	1. 5 μ sec
y = 8 0	5. 0 μ sec

10⁵回書き換後の再生信号のC/N

y = 2 0	4 2 dB
y = 2 5	4 6 dB
y = 3 0	4 9 dB
y = 3 4	5 0 dB
y = 4 0	5 0 dB
y = 5 0	5 0 dB
y = 6 0	5 0 dB

This result shows that there is little property change by many rewritings of 105 times in the Te content y in the range of 25<=y<=75.

[0202] (Relation with the presentation of elements other than Cr) Change of the bit error rate when placing for 1000 hours into germanium65Te25Cr10, and Sb30Te60 the crystallization temperature of the non-recorded part at the time of changing a presentation on straight-line ** which set constant Cr content which connects Cr10, and carrying out a temperature up with constant speed, and 80-degreeC and 95% of relative humidity of the triangular phase diagram of drawing 6 was measured. Consequently, the following data were obtained.

[0203]

Crystallization temperature Sb30Te60Cr10 120-degreeC Sb28Te58germanium4Cr10 150-degreeC
 Sb25Te55germanium10Cr10 160-degreeC Sb22Te51germanium17Cr10 170-degreeC
 Sb12Te38germanium40Cr10 190-degreeC Sb2Te28germanium60Cr10 220-degreeC Change of a bit error rate
 102 times as many Sb30Te60Cr as this Sb28Te58germanium4Cr10 Twice Sb25Te55germanium10Cr10 Twice
 Sb22Te51germanium17Cr10 2.5 times Sb12Te38germanium40Cr10 4 times Sb2Te23germanium60Cr10 5
 times, sufficiently high crystallization temperature is acquired and this result shows that change of a bit error
 rate is not so large under heat and high humidity, even if the presentation of those other than Cr changes.

[0204] Change of the bit error rate when placing for 1000 hours into Sb45Te45Cr10, and germanium18Te72 the crystallization temperature at the time of changing a presentation on straight-line ** which set constant Cr content which connects Cr10, and carrying out a temperature up with constant speed, and 80-degreeC and 95% of relative humidity of the triangular phase diagram of drawing 6 was measured. Consequently, the following data were obtained.

[0205]

Crystallization temperature Sb2Te71germanium17Cr10 210-degreeC Sb4Te69germanium17Cr10 200-degreeC
 Sb8Te67germanium15Cr10 190-degreeC Sb23Te58germanium9Cr10 170-degreeC
 Sb30Te54germanium6Cr10 150-degreeC Sb38Te49germanium3Cr10 130-degreeC Sb41Te47germanium2Cr10
 110-degreeC Change of a bit error rate Sb2Te71germanium17Cr10 5 times Sb4Te69germanium17Cr10 3
 times Sb8Te67germanium15Cr10 Twice Sb23Te58germanium9Cr10 1.5 times Sb30Te54germanium6Cr10 1.5
 time Sb38Te49germanium3Cr10 1 time Sb41Te47germanium2Cr10 1 time, sufficiently high crystallization
 temperature is acquired and this result shows that change of a bit error rate is not so large under heat and
 high humidity, even if the presentation of those other than Cr changes.

[0206] The ratio (p/x) of the content x of the contents p and Sb of germanium was changed, and the following result was obtained when change of the bit error rate when placing into the temperature C of 80 degrees and 95% of relative humidity for 1000 hours was measured.

[0207]

ピット・エラーレートの変化

(p/x) = 0. 1 5	2. 0 倍
(p/x) = 0. 2 5	1. 5 倍
(p/x) = 0. 5	1. 5 倍
(p/x) = 1. 0	1. 5 倍
(p/x) = 2. 0	3. 0 倍

This result shows that especially change of a bit error rate is small, if the range of the ratio (p/x) of the content x of the contents p and Sb of germanium is $0.25 \leq (p/x) \leq 1.0$.

[0208] When keeping the content x of the Sb pair Te pair germanium which is the remainder of Cr4Te5, and the ratio of y and p at x:y:p=2:5:2, changing the content of Cr4Te5 and C/N of the regenerative signal after rewriting the power of a laser beam 105 times on the severe conditions made higher 15% than an optimum value was measured, the following results were obtained about the content q of Cr.

[0209]

Regenerative-signal C/N after 105 times rewriting $q = 0$ 42dB $q = 3$ 46dB $q = 4$ 48dB $q = 10$ 50dB $q = 20$ 50dB $q = 34$ When the content q of 48dB Cr was changed, the "elimination ratio" of the regenerative signal after rewriting the power of a laser beam 105 times on the severe conditions made higher 15% than an optimum value changed as follows.

[0210] An "elimination ratio" expresses the ratio of the signal before and behind overwrite when carrying out overwrite of another signal with which frequencies differ on the already recorded signal with dB here.

[0211]

消去比

q = 2 2	2 5 dB
q = 3 4	2 3 dB
q = 4 0	2 0 dB
q = 5 0	1 7 dB

This result shows that an elimination ratio falls as the content q of Cr increases.

[0212] When keeping the content y of Te constant and changing the content x of Sb by the system which added above Cr 10%, C/N of the regenerative signal after rewriting the power of a laser beam 105 times on the severe conditions made higher 15% than an optimum value changed as follows.

[0213]

C/N of the regenerative signal after 105 times rewriting $x = 38$ 48dB $x = 30$ 50dB $x = 15$ 50dB $x = 8$ 50dB $x = 4$ 48dB $x = 2$ 46dB $x = 0$ From this result, 45dB is understood that C/N of a regenerative signal with the content x of Sb good in 2% or more of range is obtained.

[0214] as mentioned above, Sb16Te55germanium16Cr133 of this example, i.e., (germanium2Sb2Te5), the record film of 7(Cr4Te5) 3 Change of the bit error rate when placing into the temperature C of 80 degrees, and 95% of relative humidity for 1000 hours 2 double less or equal, C/N and the elimination ratios of a regenerative signal after rewriting the power of a laser beam 105 times on the severe conditions made higher 15% than an optimum value were 50dB or more and 28dB or more, respectively, and 2x105 rewritings or more were possible, and it turned out that it has the extremely excellent property.

[0215] (Other examples 1 of an alloying element) Even if it replaces with a part or all of Cr and adds at least one of Ag, Cu, Ba, Co, La, nickel, Pt, Si, Sr, and lanthanoidses, the property just like the above-mentioned case is acquired. For example, the following data were obtained when Cu was added (the addition of Cu: q).

[0216]

書き換え可能回数

q = 0	5×10^4 回
q = 1. 0	8×10^4 回
q = 4. 0	1×10^5 回
q = 10. 0	2×10^5 回
q = 20. 0	2×10^5 回
q = 34. 0	2×10^5 回
q = 40. 0	1×10^6 回

This result shows that a rewritable count increases notably, when Cu is added.

[0217] (Other examples 2 of an alloying element) It is desirable to add Tl (thallium) with the effectiveness which accelerates elimination and enlarges C/N in addition to Cr. In this case, since C/N becomes still larger than the case where only Cr is added and a rewritable count also becomes large, it is more desirable. However, the direction which makes the sum of the addition of Cr and Tl below 30 atom % disappears, and the remainder does not become large, but it is desirable. 0.5% or more, if the sum of the addition of Cr and Tl is below 20 atom %, it is still more desirable.

[0218] For example, with germanium8.2Sb16.4Te64.4Tl0.5Cr10.5 record film, it is C/N. 50dB, rewritable count 2x105 times was obtained.

[0219] It replaces with a part or all of Tl, and the property which could add at least one of the halogens, and was alike is acquired.

[0220] When it replaces with Tl and N (nitrogen) is added, a rewritable count improves further. However, if many [too], regenerative-signal level will fall.

[0221] (Other examples 3 of an alloying element) In addition to this, Tl (thallium) is permuted by Se, and when below 10 atom % adds Se more than 1 atom %, keeping the relative ratio of other elements constant, there is effectiveness on an anti-oxidation disposition.

[0222] (Other examples of a phase change component) Even if it replaces a part of germanium2Sb2Te5 which is the phase change component of this example by at least one of the presentations near GeSb2Te4, GeSb4Te7, In3SbTe2, In35Sb32Te33, In31Sb26Te43, and these and transposes some germanium to In, the property near this is acquired.

[0223] (Other examples of a high-melting component) A compound is sufficient as the high-melting component which deposits, and an element simple substance and an alloy are sufficient as it. A part or all of Cr4Te5 that is the high-melting components of this example LaTe2, La2Te3, La3Te4, LaTe, and La2 -- Te5 and La4 -- Te7, LaTe3, La3Te, La2Sb, La3Sb2, LaSb, LaSb2, La3germanium, La5germanium3, La4germanium3, La5germanium4, LaGe, and La3 -- germanium5 and Ag -- 2 Te It PtGe(s). Cr5Te8, Cr2Te3, CrSb, Cr3germanium, Cr5germanium3, Cr11germanium8, CrGe, and Cr11 -- germanium19, PtTe2, Pt4Te5, Pt5Te4, Pt4Sb, Pt3Sb2, PtSb, Pt3germanium, Pt2germanium, and Pt3germanium2 -- It NiGe(s). Pt2 -- germanium3, PtGe3, NiTe, NiTe 0.85, NiSb, nickel3germanium, nickel5germanium2, and nickel5germanium3 -- CoTe2, CoSb2, CoSb3, Co5germanium2, Co5germanium3, CoGe, and Co5 -- germanium7, CoGe2, Si2Te3, SiSb, SiGe, CeTe, Ce3Te4, Ce2Te3, Ce4Te7, CeTe2 and CeTe3, Ce2Sb, and Ce5Sb3 -- Ce4Sb5, CeSb, CeSb2, Ce3germanium, Ce5germanium3, Ce4germanium3, Ce5germanium4, CeGe, Ce3germanium5, Ce5Si3, Ce3Si2, Ce5Si4, CeSi, and Ce3 -- Si5, CeSi2, Cr3Si, Cr5Si3, CrSi, and CrSi3 -- CrSi2, Co3Si, CoSi, CoSi2 and NiSi2, NiSi, nickel3Si2, nickel2Si, nickel5Si2, nickel3Si, Pt5Si2, Pt2Si, PtSi, LaSi2, Ag3In, Ag2In, Bi2Ce, BiCe, Bi3Ce4, Bi3Ce5, BiCe2, Cd11Ce, Cd6Ce, Cd58Ce13, Cd3Ce, Cd2Ce, CdCe, Ce3In, Ce2In, Ce1+xIn, Ce3In5, CeIn2 and CeIn3, Ce2Pb, CePb, CePb3, Ce3Sn, Ce5Sn3, Ce5Sn4, Ce11 -- Sn10 and Ce3 -- Sn5 and Ce3 -- Sn7 and Ce2 -- Sn5, CeSn3, CeZn, CeZn2 and CeZn3, Ce3Zn11, Ce13Zn58, and CeZn5 and Ce3 -- Zn22 and Ce2 -- Zn17, CeZn11, Cd21Co5, CoGa, and CoGa3 -- CoSn, Cr3Ga, CrGa, and Cr5 -- Ga6, CrGa4, Cu9Ga4, Cu3Sn, Cu3Zn, Bi2La, BiLa, and Bi3 -- La4 and Bi3 -- La5, BiLa2, Cd11La, Cd17La2, Cd9La2, Cd2La, CdLa, and Ga -- 6 La It LaZn(s). Ga2La, GaLa, and Ga3 -- La5, GaLa3, In3La, In2La, In5La3, InxLa, InLa, and InLa2, InLa3 and La5 -- Pb3 and La4 -- Pb3, La11Pb10, La3Pb4, La5Pb4, and LaPb2 and LaPb3 -- LaZn2, LaZn4, LaZn5, La3Zn22, La2Zn17, LaZn11 and LaZn13, NiBi, Ga3nickel2, GaNi, and Ga2 -- nickel3 and Ga3 -- nickel5, GaNi3, nickel3Sn, nickel3Sn2, nickel3Sn4, NiZn, and nickel5Zn21 -- PtBi, PtBi2, PtBi3 and PtCd2, Pt2Cd9, Ga7Pt3, Ga2Pt, Ga3Pt2, GaPt, and Ga3 -- Pt5, GaPt2, GaPt3, In7Pt3, In2Pt, In3Pt2, InPt, and In5 -- Pt6 and In2 -- Pt3 and InPt2 -- InPt3, Pt3Pb, PtPb, Pt2Pb3, Pt3Sn, PtSn, Pt2Sn3, PtSn2 and PtSn4, Pt3Zn, PtZn2 and AIS, aluminum2S3, BaS, BaC2 and CdS, Co4S3, Co9S8, CoS, CoO and Co 2O4, Co2O3, Cr 2O3, Cr3O4, CrO, CrS and CrN, Cr2N, Cr23C63, Cr7C3, Cr3C2, Cu2S, Cu9S5, CuO, Cu2O, In4S5, In3 S4, La2S3, La 2O3, Mo2C, MoC, Mn23C6, Mn4C, Mn7C3, Among the oxides of the configuration element of NiO, SiS2, SiO2, Si3N4, and the above-mentioned high-melting component, a high-melting thing, Cu2Te, CuTe, Cu3Sb, Mn2Sb, MnTe, MnTe2, Mn5germanium3, Mn3.25germanium, Mn5germanium, Mn3germanium2, germanium3W, Te2W, AISb, aluminum2Te3, Fe2germanium, FeGe2 and FeSb2, Mo3Sb7, Mo3Te4, MoTe2, PbTe, and GePd2 and germanium2 -- Pd5 and germanium9 -- Pd25, GePd5, Pd3Sb, Pd5Sb3, PdSb, SnTe, Ti5germanium3, germanium31V17, germanium8V11, germanium3V5, GeV3, V5Te4, V3Te4, ZnTe, and Ag -- 2 Se The high-melting compound containing the element of B groups, such as Cu2Se, aluminum2Se3, InAs, CoSe, Mn3In, nickel3In, NiIn, nickel2In3, nickel3In7, and PbSe, or the thing of the presentation near it, Or the same result is obtained even if it replaces by at least one of the 3 yuan or more compounds near these mixed presentations and mixed presentations.

[0224] among these -- LaSb, CrSb, CoSb, and Cr3 -- especially at least one of Te4, LaTe3, Cr4Te5, Cr2Te3,

Cr₃Te₄, CoTe, Co₃Te₄, Cu₂Te, CuTe, Cu₃Sb, MnTe, MnTe₂, and Mn₂Sb(s) is desirable. It is because record / elimination property is stabilized in initial crystallization of a small count.

[0225] (Amount of the inclusion of a high-melting component) As for the content of the oxide contained in the sludge of a high-melting component, a sulfide, a nitride, and carbide, it is desirable to carry out to under 40 atom % of a high-melting component, and it is desirable especially to carry out to under 10 atom %. If there are many these contents, the difference of complex index of refraction with a phase change component cannot be made small, or it will be easy to produce the problem which oxygen etc. is spread [problem] and degrades record and a read-out property in a phase change component.

[0226] With many aforementioned compounds described as an example of a high-melting component, when content v' of a transition-metals element differed, the interface reflection factor of record film 3 changed as follows.

[0227]

界面反射率

v' = 2 5 %	1 %
v' = 3 5 %	2 %
v' = 5 0 %	6 %

This result shows that an interface reflection factor increases, when content v' of a transition-metals element increases.

[0228] (Content of the high-melting compound in the thin film for record) Content a' of the high-melting compound contained in the thin film for record When it expresses with the rate (atomic %) to the sum of the atomic number of all the configuration elements of the high-melting component of the sum of the atomic number of the configuration element of the high-melting compound and the content a' is changed, a rewritable count, The elimination ratio after rewriting laser power 105 times on the severe conditions made high 15% changed as follows. Change of this C/N is based mainly on change of C level.

[0229]

A rewritable count a'= Pentatomic % 4x104 times a'=10 atom % 1x105 times a'=20 atom % 1.5x105 times a'=30 atom % 2x105 times The elimination ratio after 105 times rewriting a'=30 atom % 30dB a'=40 atom % 30dB a'=50 atom % 25dB a'=60 atom % -- when content a' of the high-melting compound contained in the thin film for record increased 23dB from this result, the rewritable count increased, but when it increased too much, it turned out that the elimination ratio after 105 times rewriting falls. Therefore, it turned out that the range of 10 atom %<=a'<=50 atom % is desirable.

[0230] (Complex index of refraction of a high-melting component) The real part n1 and imaginary part (extinction coefficient) k1 of complex index of refraction of a high-melting component When difference $\Delta n = (|n_1 - n_2| / n_1) \times 100$ with those values n2 and k2 of the crystallization condition of a phase change component differ from $\Delta k = (|k_1 - k_2| / k_1) \times 100$, After rewriting the power of a laser beam 105 times on the severe conditions made higher 15% than an optimum value, C/N of a regenerative signal changed as follows. This change of C/N is based mainly on change of N level.

[0231]

C/N of the regenerative signal after 105 times rewriting Δk , $\Delta n = 10\% 49dB$ Δk , $\Delta n = 20\% 48dB$ Δk , $\Delta n = 30\% 47dB$ Δk , $\Delta n = 40\% 46dB$ Δk , $\Delta n = 50\% 43dB$ From this result, 43dB of differences Δn and Δk of the real part of complex index of refraction and imaginary part (extinction coefficient) was understood that the smaller one is desirable.

[0232] (The configuration and dimension of the sludge of a high-melting component) High-melting components, such as Cr₄Te₅ mentioned above, deposit inside record film 3 with a gestalt as shown in drawing 1 (a), (b), and (c).

[0233] At drawing 1 (a), after the sludge of much granular high-melting component 3b has become independent, it is distributed in record film 3. Parts other than high-melting component 3b of record film 3, i.e., a residual element, are phase change component 3a. Even if lay length perpendicular to a film surface is almost the same as the film surface lay length of high-melting component 3b or it differs, the difference of these die length is small. Here, the thing with the sludge of high-melting component 3b touches one interface of record film 3, and the thing with others is in contact with neither of the interfaces.

[0234] In high-melting component 3b, by the medium of drawing 3, Cr₄Te₅ and phase change component 3a consist of germanium₂Sb₂Te₅.

[0235] In drawing 1 (b), the point of being distributed in record film 3 after the sludge of much high-melting component 3b has become independent is the same as the case of drawing 1 (a). However, it differs in that high-melting component 3b deposits in the shape of a column. That is, the lay length perpendicular to a film

surface is larger, and it consists column-like of film surface lay length of high-melting component 3b in the cross section perpendicular to a film surface. The thing with the sludge of high-melting component 3b is in contact with one interface of record film 3, and the thing with others is in contact with the interface of another side of record film 3. Here, what is in contact with both interfaces does not exist.

[0236] At drawing 1 (c), the sludge of much high-melting component 3b is connected mutually, and is distributed in record film 3 in the condition of having become in one. That is, high-melting component 3b deposits in the shape of porosity, and phase change component 3a will be embedded into many stomata of the high-melting component 3b. Porous high-melting component 3b is in contact with the interface of both record film 3. Phase change component 3a is distributed in record film 3, where mutually-independent is carried out. This condition is equivalent to what replaced phase change component 3a and high-melting component 3b in the case of drawing 1 (a).

[0237] Although either of the conditions of (a) – (c) of drawing 1 appears according to membrane formation conditions or initial crystallization conditions, even if it is in which condition, a flow and segregation of heating and phase change component 3a at the time of carrying out melting are prevented by high-melting component 3b in record film 3, consequently a rewritable count improves.

[0238] this -- invention -- setting -- high-melting -- a component -- three -- b -- a sludge -- " -- max -- a dimension -- d -- ' -- " -- height -- h -- and -- h -- ' -- " -- a pitch -- " -- " -- the maximum hole dimension -- " -- and -- " -- max -- wall thickness -- " -- a definition shall be given as follows, respectively

[0239] As shown in (a) of drawing 1 , and (b), when the sludge of high-melting component 3b is distributed independently, like drawing 2 (b), a cross section (henceforth the 1st criteria cross section) parallel to the film surface of record film 3 in the location which only (one third of the distance) of the thickness T of record film 3 separated from one interface of record film 3 is considered, and the die length of the sludge of each high-melting component 3b in the cross section is measured. And maximum of the die length measured in the direction of arbitration is made into "maximum dimension d".

[0240] When "maximum dimension d" specifically has a circular or circularly near configuration [in / like drawing 2 (a) / the 1st criteria cross section], the diameter of a sludge is meant, when close to an ellipse form or an ellipse form, the major axis of a sludge is meant and, in the case of a polygon, the die length of the longest diagonal line of a sludge is meant.

[0241] "Height h" considers a cross section (henceforth the 2nd criteria cross section) perpendicular to the film surface of record film 3, and measures lay length perpendicular to the film surface of the record film 3 of the sludge of each high-melting component 3b in the cross section. In this way, obtained die length is set to "height h" of the sludge of high-melting component 3b.

[0242] As shown in drawing 4 (a), this "height h" is applied, when the sludge of granular high-melting component 3b is distributed, and when the sludge of column-like high-melting component 3b is distributed in contact with the interface of both record film 3 as shown in drawing 4 (b).

[0243] Although "height h" and "height h'" are the same views as the above "height h", when the sludge of column-like high-melting component 3b is distributed only in contact with the interface of one of the two of record film 3, and not touching an interface, only the points applied, respectively differ [as shown in drawing 4 (c)].

[0244] "Pitch i" means the two adjoining averages of the distance of the center to center of the sludge of high-melting component 3b in said 1st criteria cross section, as shown in drawing 2 (a).

[0245] "Maximum hole dimension p'" is applied when porous high-melting component 3b deposits, as shown in drawing 1 (c), and it means the maximum of the magnitude of each hole of the sludge of high-melting component 3b in said 1st criteria cross section.

[0246] a hole [in / like drawing 5 / specifically / in this "maximum hole dimension p'" / the 1st criteria cross section] -- when circular [a configuration] or circularly near, the diameter of a hole is meant, when close to an ellipse form or an ellipse form, the major axis of a hole is meant and, in the case of a polygon, the die length of the longest diagonal line of a hole is meant.

[0247] Like "maximum hole dimension p'", "maximum wall thickness w" is applied, when porous high-melting component 3b deposits, and it means the maximum of the thickness of the wall between two holes with which the sludge of high-melting component 3b adjoins in said 1st criteria cross section like drawing 5 .

[0248] (Relation with the dimension of the sludge of a high-melting component) When "maximum dimension d" of the sludge of high-melting component 3b differed, C/N of the regenerative signal after rewriting a rewritable count and the power of a laser beam 105 times on the severe conditions made higher 15% than an optimum value changed as follows. This change of C/N is based mainly on change of N level.

[0249]

A rewritable count $d'=50\text{nm}$ 2x105 times $d'=30\text{nm}$ 2x105 times $d'=10\text{nm}$ 2x105 times $d'=5\text{nm}$ 1.5x105 times $d'=1\text{nm}$ 4x104 times C/N of the regenerative signal after 105 times rewriting $d'=80\text{nm}$ 46dB $d'=50\text{nm}$ 47dB $d'=20\text{nm}$ 49dB $d'=15\text{nm}$ 49dB $d'=5\text{nm}$ 50dB was understood that the range of $5\text{nm} \leq d' \leq 50\text{nm}$ is more desirable than this result.

[0250] When column-like high-melting component 3b deposited from the interface of the both sides of record film 3 and "height h" of a sludge differed like drawing 4 (b), the rewritable count changed as follows.

[0251]

書き換え可能回数

$h = 30\text{nm}$	2×10^6 回
$h = 20\text{nm}$	1.5×10^6 回
$h = 10\text{nm}$	1×10^6 回
$h = 0\text{nm}$	4×10^4 回

It turned out that the range of $10\text{nm} \leq h$ is more desirable than this result.

[0252] When column-like high-melting component 3b deposited from the interface of one side of record film 3 and "height h" of a sludge differed like drawing 4 (c), the rewritable count changed as follows.

[0253]

書き換え可能回数

$h' = 20\text{nm}$	2×10^6 回
$h' = 10\text{nm}$	1.5×10^6 回
$h' = 5\text{nm}$	1×10^6 回
$h' = 1\text{nm}$	4×10^4 回

When column-like high-melting component 3b was not in contact with the interface of record film 3 and "height h" of a sludge differed, the rewritable count changed as follows.

[0254]

書き換え可能回数

$h'' = 20\text{nm}$	2×10^5 回
$h'' = 10\text{nm}$	1.5×10^5 回
$h'' = 5\text{nm}$	1×10^5 回
$h'' = 1\text{nm}$	4×10^4 回

This result showed $5\text{nm} \leq h$ being and that the range of h was desirable.

[0255] When "Pitches i" differed, C/N of the regenerative signal after rewriting a rewritable count and the power of a laser beam 105 times on the severe conditions made higher 15% than an optimum value changed as follows. Change of this C/N is based mainly on change of C level.

[0256]

A rewritable count $i = 120\text{nm}$ 8x104 times $i = 90\text{nm}$ 1.5x105 times $i = 70\text{nm}$ 1.8x105 times $i = 60\text{nm}$ 2x105 times $i = 40\text{nm}$ 2x105 times $i = 15\text{nm}$ 2x105 times C/nickel=70nm of the regenerative signal after 105 times rewriting 50dB $i = 40\text{nm}$ 50dB $i = 30\text{nm}$ 49dB $i = 20\text{nm}$ 46dB $i = 15\text{nm}$ 45dB $i = 10\text{nm}$ 44dB $i = 5\text{nm}$ was understood that the range of $20\text{nm} \leq i \leq 90\text{nm}$ is more desirable than this result 40 dB.

[0257] When high-melting component 3b was connected in the direction of a film surface, and deposited as the shape of porosity like drawing 1 (c) and "maximum hole dimension p'" of a sludge differed, the rewritable count changed as follows.

[0258]

書き換え可能回数

$p''' = 50\text{nm}$	1.5×10^6 回
$p''' = 60\text{nm}$	1.5×10^6 回
$p''' = 80\text{nm}$	1×10^6 回
$p''' = 100\text{nm}$	4×10^4 回

It turned out that the range of $p'' \leq 80\text{nm}$ is more desirable than this result.

[0259] When "maximum wall thickness w" of porous high-melting component 3b differed, C/N of the regenerative signal after rewriting laser beam power 105 times on the severe conditions made higher 15% than an optimum value changed as follows. Change of this C/N is based mainly on change of C level.

[0260]

C/N of the regenerative signal after 105 times rewriting $w = 5\text{nm}$ 50dB $w = 15\text{nm}$ 49dB $w = 20\text{nm}$ 46dB $w = 35\text{nm}$ 40dB was understood that the range of $w \leq 20\text{nm}$ is more desirable than this result.

[0261] (Relation with the melting point of a high-melting component) When the melting points (m. p.) of high-melting component 3b which deposits in record film 3 differed, that a rewritable count changes as follows has guessed by the computer simulation.

[0262]

書き換え可能回数

m. p. = 600°C	7 × 10 ⁴ 回
m. p. = 780°C	1. 5 × 10 ⁵ 回
m. p. = 930°C	2 × 10 ⁵ 回

It turned out that the melting point of high-melting component 3b has the desirable range more than 780-degreeC, and the range more than 930-degreeC is more more desirable than this result.

[0263] When the differences of the melting point of the residual element (phase change component 3a) after high-melting component 3b deposits, and the melting point of high-melting component 3b differed, it has also guessed by the computer simulation that a rewritable count changed as follows.

[0264]

Rewritable count The difference of m.p. = 0-degreeC 7x104 times The difference of m.p. = 150-degreeC 1.5x105 times The difference of m.p. = 300-degreeC It turned out that the difference of the melting point has the desirable range more than 150-degreeC, and the range more than 300-degreeC is more more desirable than this result 2x105 times.

[0265] (Relation with the difference of the crystallization temperature for a high-melting component and a phase change) The temperature up was carried out with the constant speed of 10-degree/m C, and the temperature from which generation of heat of crystallization begins was measured. When the difference s of the crystallization temperature of high-melting component 3b and low-melt point point component 3a which causes a phase change was searched for from the result, the rewritable count changed with temperature gradients s as follows.

[0266]

書き換え可能回数

s = 5°C	4 × 10 ⁴ 回
s = 10°C	1 × 10 ⁵ 回
s = 30°C	1. 5 × 10 ⁵ 回
s = 40°C	2 × 10 ⁵ 回

It turned out that the difference of the melting point has the desirable range more than 10-degreeC, and the range more than 30-degreeC is more more desirable than this result.

[0267] (Relation with the high-melting component made to cover at the time of membrane formation) When manufacturing the thin film for information record of this example, high-melting component Cr₄Te₅ was made to put at an early process, but when average thickness c' of that high-melting component Cr₄Te₅ was changed as follows, C/N of the regenerative signal after rewriting a rewritable count and the power of a laser beam 105 times on the severe conditions made higher 15% than an optimum value changed as follows. Change of this C/N is based mainly on change of C level.

[0268]

A rewritable count $c' = 0\text{nm}$ 5x104 times $c' = 1\text{nm}$ 1x105 times $c' = 5\text{nm}$ 2x105 times C/N of the regenerative signal after 105 times rewriting $c' = 1\text{nm}$ 47dB $c' = 5\text{nm}$ 47dB $c' = 10\text{nm}$ 46dB $c' = 20\text{nm}$ was understood that the range of $1\text{nm} \leq c' \leq 10\text{nm}$ is more desirable than this result 40 dB.

[0269] (in addition to this) Although the protective layer 2 and the interlayer 4 are formed by ZnS-SiO₂ in this example It replaces with ZnS-SiO₂. Oxides, such as a Si-N system ingredient, a Si-O-N system ingredient, SiO₂, SiO, TiO₂ and aluminum 2O₃, Y₂O₃, CeO and La 2O₃, In₂O₃, GeO, GeO₂, PbO, SnO, SnO₂ and Bi 2O₃, TeO₂, WO₂ and WO₃, Sc₂O₃, and ZrO₂, TaN, Nitrides, such as AlN, Si₃N₄, and an aluminum-Si-N system ingredient (for example, AlSiN₂), Sulfides, such as ZnS, Sb₂S₃, CdS, In₂S₃, Ga₂S₃, GeS, SnS₂ and PbS, and Bi₂S₃, Selenides, such as SnSe₂, Sb₂Se₃, CdSe, ZnSe, In₂Se₃, Ga₂Se₃, GeSe, GeSe₂, SnSe, PbSe, and Bi₂Se₃, Fluorides, such as CeF₃, MgF₂, and CaF₂, or Si, germanium and TiB₂, B₄C, B, and C, or the thing of the presentation near the above-mentioned ingredient may be used. Moreover, the layers and these multiplex layers of these charges of an admixture are sufficient.

[0270] the case where an interlayer 4 is omitted -- record sensibility -- about 30% -- falling -- also remaining unmelted -- it increased about 5dB. The rewritable count also decreased.

[0271] When an interlayer's 4 refractive index was in 1.7 or more and 2.3 or less range, C/N 50dB or more was obtained for thickness, respectively in the range of 3nm or more and 100nm or less and 180nm or more, and 400nm or less.

[0272] Instead of aluminum-Ti used for the reflecting layer 5 in this example, the element simple substance of Au, Ag, Cu, aluminum, nickel, Fe, Co, Cr, Ti, Pd, Pt, W, Ta, Mo, and Sb, Or the layer which consists of an alloy which makes these a principal component, or these comrades' alloy may be used, the multiplex layer which consists of those layers may be used, and the compound layer of these and other matter, such as an oxide, etc. may be used.

[0273] In this example, directly, although the polycarbonate substrate 1 in which the irregularity of a tracking guide etc. was formed is used for the front face instead, the chemically strengthened glass in which polyolefine, epoxy, acrylic resin, and a UV-cured resin layer were formed on the front face etc. may be used for it.

[0274] Even if the configuration of the simple laminated structure 3 which omitted a part of interlayer 4, reflecting layer 5, and protective layer 2, for example, the 2/record film of 1/protective layers of substrates, the 3/interlayer 4 of 1/record film of substrates, the 3/reflecting layer 5 of 1/record film of substrates, etc. also rewrote many times compared with the conventional thing, the noise rise had it, and the good result was obtained. [little]

[0275] As stated above, many rewritings of single or more figures are more possible for the thin film for information record of this example than before, keeping good record and playback / elimination property. Moreover, there is also an advantage that the power of the laser beam used for record and elimination may be low.

[0276] [Example 2] In the record film 5 of the Sb-Te-germanium-Cr system of an example 1, the thin film for information record was manufactured like the example 1 except Cr12In35Sb12Te40 of the Sb-Te-In-Cr system equivalent to what all permuted germanium by In, i.e., (Cr4Te5), the point which formed record film 5 by 2(In3SbTe2) 7. Moreover, it was presupposed that the record / playback approach of initial crystallization of the thin film concerned and the information on subsequent is the same as that of an example 1.

[0277] (Relation with the presentation of elements other than Cr) Cr content was set constant and change of the bit error rate when placing for 1000 hours into In65Te25Cr10, and Sb30Te60 the crystallization temperature of the non-recorded part at the time of carrying out a temperature up with constant speed, when other presentations were changed on the straight line which connects Cr10, and 80-degreeC and 95% of relative humidity of a triangular phase diagram (not shown) was as follows.

[0278]

Crystallization temperature Sb30Te60Cr10 120-degreeC Sb22Te51In17Cr10 140-degreeC
 Sb18Te47In25Cr10 150-degreeC Sb10Te35In45Cr10 170-degreeC Sb7Te33In50Cr10 180-degreeC
 Sb2Te8In60Cr10 220-degreeC Change of a bit error rate Sb22Te51In17Cr10 2 twice Sb18Te47In25Cr10
 Twice Sb10Te35In45Cr10 Twice Sb7Te33In50Cr10 2.5 times Sb2Te8In60Cr10 4 times, from this result, even if the presentation of those other than Cr changes, sufficiently high crystallization temperature is acquired and many rewritings of 105 times also show that change of a bit error rate is not so large.

[0279] Cr content was set constant and change of the bit error rate when placing for 1000 hours into Sb65Te25Cr10, and In47Te43 the crystallization temperature at the time of carrying out a temperature up with constant speed, when the presentation was changed on the straight line which connects Cr10, and 80-degreeC and 95% of relative humidity of the same triangular phase diagram was as follows.

[0280]

Crystallization temperature Sb2Te42In46Cr10 210-degreeC Sb4Te42In44Cr10 200-degreeC
 Sb8Te41In41Cr10 190-degreeC Sb15Te39In36Cr10 180-degreeC Sb30Te34In26Cr10 150-degreeC
 Sb38Te32In20Cr10 130-degreeC Sb41Te32In17Cr10 110-degreeC Change of a bit error rate
 Sb2Te42In46Cr10 5 times Sb4Te42In44Cr10 3 times Sb8Te41In41Cr10 Twice Sb15Te39In36Cr10 1.5 times
 Sb30Te34In26Cr10 1.5 times Sb38Te32In20Cr10 1 time Sb41Te32In17Cr10 1 time, from this result, even if the presentation of those other than Cr changes, sufficiently high crystallization temperature is acquired and many rewritings of 105 times also show that change of a bit error rate is not so large.

[0281] When the ratio (p/x) of the content x of the contents p and Sb of In was changed, change of the bit error rate when placing into 80-degreeC and 95% of relative humidity for 1000 hours was as follows.

[0282]

Change of a bit error rate (p/x) = [0.5] 3.0 times (p/x) = [1.0] 2.0 times (p/x) = [2.0] 2.0 times (p/x) = [3.0] 2.0 times (p/x) = 4.0 3.0 times, this result shows that change of a bit error rate is small, if the range of

the ratio (p/x) of the content x of the contents p and Sb of In is $1.0 \leq (p/x) \leq 3.0$.

[0283] In what [what replaced Cr with Cu], i.e., an In-Sb-Te-Cu system, also when changing the ratio (p/x) of the content x of the contents p and Sb of In similarly, the same result was obtained.

[0284] (Other examples of a phase change component) A near property is acquired, even if it replaces a part of In₃SbTe₂ which is a phase change component by at least one of germanium₂Sb₂Te₅, GeSb₄Te₇, GeSb₂Te₄, In₃₅Sb₃₂Te₃₃, and In₃₁Sb₂₆Te₄₃ and transposes a part of In to germanium.

[0285] (Other examples of a high-melting component) A part of Cr₄Te₅ which is a high-melting component LaTe₃, LaTe₂, La₂Te₃, La₃Te₄, LaTe, La₂Te₅, LaSb, and La₄ — Te₇ and La₃ — Te and La₂ — Sb and La₃ — Sb₂, LaSb₂, La₃germanium, La₅germanium₃, La₄germanium₃, La₅germanium₄, LaGe, and La₃germanium₅ — Ag₂Te, Cr₅Te₈, Cr₂Te₃, CrSb, Cr₃germanium, Cr₅germanium₃, Cr₁₁germanium₈, CrGe, and Cr₁₁ — germanium₁₉, PtTe₂, Pt₄Te₅, Pt₅Te₄, Pt₄Sb, Pt₃Sb₂, PtSb, Pt₃germanium, Pt₂germanium, and Pt₃germanium₂ — It NiGe(s). PtGe and Pt₂ — germanium₃, PtGe₃, NiTe, NiTe 0.85, NiSb, nickel₃germanium, nickel₅germanium₂, and nickel₅germanium₃ — CoTe₂, CoSb₂, CoSb₃, Co₅germanium₂, Co₅germanium₃, CoGe, and Co₅ — germanium₇, CoGe₂, Si₂Te₃, SiSb, SiGe, CeTe, Ce₃Te₄, Ce₂Te₃, Ce₄Te₇, CeTe₂ and CeTe₃, Ce₂Sb, and Ce₅Sb₃ — Ce₄Sb₅, CeSb, CeSb₂, Ce₃germanium, Ce₅germanium₃, Ce₄germanium₃, Ce₅germanium₄, CeGe, Ce₃germanium₅, Ce₅Si₃, Ce₃Si₂, Ce₅Si₄, CeSi, and Ce₃ — Si₅, CeSi₂, Cr₃Si, Cr₅Si₃, CrSi, and CrSi₃ — CrSi₂, Co₃Si, CoSi, CoSi₂ and NiSi₂, NiSi, nickel₃Si₂, nickel₂Si, nickel₅Si₂, nickel₃Si, Pt₅Si₂, Pt₂Si, PtSi, LaSi₂, Ag₃In, Ag₂In, Bi₂Ce, BiCe, Bi₃Ce₄, Bi₃Ce₅, BiCe₂, Cd₁₁Ce, Cd₆Ce, Cd₅₈Ce₁₃, Cd₃Ce, Cd₂Ce, CdCe, Ce₃In, Ce₂In, Ce_{1+x}In, Ce₃In₅, CeIn₂ and CeIn₃, Ce₂Pb, CePb, CePb₃, Ce₃Sn, Ce₅Sn₃, Ce₅Sn₄, Ce₁₁ — Sn₁₀ and Ce₃ — Sn₅ and Ce₃ — Sn₇ and Ce₂ — Sn₅, CeSn₃, CeZn, CeZn₂ and CeZn₃, Ce₃Zn₁₁, Ce₁₃Zn₅₈, and CeZn₅ and Ce₃ — Zn₂₂ and Ce₂ — Zn₁₇, CeZn₁₁, Cd₂₁C₅, CoGa, and CoGa₃ — CoSn, Cr₃Ga, CrGa, and Cr₅ — Ga₆, CrGa₄, Cu₉Ga₄, Cu₃Sn, Cu₃Zn, Bi₂La, BiLa, and Bi₃ — La₄ and Bi₃ — La₅, BiLa₂, Cd₁₁La, Cd₁₇La₂, Cd₉La₂, Cd₂La, CdLa, and Ga — 6 La It LaZn(s). Ga₂La, GaLa, and Ga₃ — La₅, GaLa₃, In₃La, In₂La, In₅La₃, InxLa, InLa, and InLa₂, InLa₃ and La₅ — Pb₃ and La₄ — Pb₃, La₁₁Pb₁₀, La₃Pb₄, La₅Pb₄, and LaPb₂ and LaPb₃ — LaZn₂, LaZn₄, LaZn₅, La₃Zn₂₂, La₂Zn₁₇, LaZn₁₁ and LaZn₁₃, NiBi, Ga₃nickel₂, GaNi, and Ga₂ — nickel₃ and Ga₃ — nickel₅, GaNi₃, nickel₃Sn, nickel₃Sn₂, nickel₃Sn₄, NiZn, and nickel₅Zn₂₁ — PtBi, PtBi₂, PtBi₃ and PtCd₂, Pt₂Cd₉, Ga₇Pt₃, Ga₂Pt, Ga₃Pt₂, GaPt, and Ga₃ — Pt₅, GaPt₂, GaPt₃, In₇Pt₃, In₂Pt, In₃Pt₂, InPt, and In₅ — Pt₆ and In₂ — Pt₃ and InPt₂ — InPt₃, Pt₃Pb, PtPb, Pt₂Pb₃, Pt₃Sn, PtSn, Pt₂Sn₃, PtSn₂ and PtSn₄, Pt₃Zn, PtZn₂ and AIS, aluminum₂S₃, BaS, BaC₂ and CdS, Co₄S₃, Co₉S₈, CoS, CoO and Co₂O₄, Co₂O₃, Cr₂O₃, Cr₃O₄, CrO, CrS and CrN, Cr₂N, Cr₂₃C₆₃, Cr₇C₃, Cr₃C₂, Cu₂S, Cu₉S₅, CuO, Cu₂O, In₄S₅, In₃S₄, La₂S₃, La₂O₃, Mo₂C, MoC, Mn₂₃C₆, Mn₄C, Mn₇C₃, NiO, SiS₂, SiO₂, Si₃N₄, Cu₂Te, CuTe, Cu₃Sb, Mn₂Sb, MnTe, MnTe₂, Mn₅germanium₃, Mn_{3.25}germanium, Mn₅germanium₂, Mn₃germanium₂, germanium₃W, Te₂W, AlSb, and aluminum₂ — Te₃ and Fe₂ — germanium and FeGe₂ — FeSb₂ and Mo₃ — Sb₇ and Mo₃ — Te₄, MoTe₂, PbTe, and GePd₂ and germanium₂ — Pd₅ and germanium₉ — Pd₂₅, GePd₅, Pd₃Sb, Pd₅Sb₃, PdSb, SnTe, Ti₅germanium₃, germanium₃₁V₁₇, germanium₈V₁₁, germanium₃V₅, GeV₃, and V₅Te₄ — Among the oxides of the configuration element of V₃Te₄, ZnTe, Ag₂Se, Cu₂Se, aluminum₂Se₃, InAs, CoSe, Mn₃In, nickel₃In, NiIn, nickel₂In₃, nickel₃In₇, PbSe, and the above-mentioned high-melting component, high-melting compounds, such as a high-melting thing. Or the same result is obtained even if it replaces by at least one of the 3 yuan or more compounds near the things or these mixed presentations, and a mixed presentation of the presentation near it.

[0286] Especially at least one of LaSb, La₂Te₃, La₃Te₄, CrSb, CoSb, Cr₃Te₄, Cr₂Te₃, Cr₃Te₄, CoTe, Co₃Te₄, Cu₂Te, CuTe, Cu₃Sb, MnTe, MnTe₂, Mn₂Sb, and Cr₄Te₅ is [among these] desirable. It is because record / elimination property is stabilized in initial crystallization of a small count.

[0287] Also in this example, a compound is sufficient as high-melting component 3b which deposits, and an element simple substance and an alloy are sufficient as it.

[0288] (Amount of the inclusion of a high-melting component) Like an example 1, as for the content of the oxide contained in the sludge of a high-melting component, a sulfide, a nitride, and carbide, it is desirable to carry out to under 40 atom % of a high-melting component, and it is desirable especially to carry out to under 10 atom %. If there are many these contents, the difference of complex index of refraction with a phase change component cannot be made small, or it will be easy to produce the problem which oxygen etc. is spread [problem] and degrades record and reproducing characteristics in a phase change component.

[0289] In addition, the matter which has not been described here is the same as an example 1.

[0290] [Example 3] In the record film 5 of the Sb-Te-germanium-Cr system of an example 1, the thin film for information record was manufactured like the example 1 except the point which formed record film 5 by Sb₁₆Te₃₉germanium₁₅Co₂₂Si₈, 27 (germanium₂Sb₂Te₅) 28 [i.e., (Co₃Si),], which replaces with Cr and contains Co and Si as an element expressed with said general formula by B or X. Moreover, it was

presupposed that the record / playback approach of initial crystallization of the thin film concerned and the information on subsequent is the same as that of an example 1.

[0291] In this example, a high-melting component is Co3Si and a phase change component is germanium2Sb2Te5.

[0292] When keeping the content x of the Sb pair Te pair germanium, and the ratio of y and p at x:y:p=2:5:2 and changing the content a of Co3Si (it corresponds to a of an example 1), change of C/N of the regenerative signal after rewriting a rewritable count and the power of a laser beam 105 times on the severe conditions made higher 15% than an optimum value was the same as that of an example 1.

[0293] (Other examples of a phase change component) A near property is acquired even if it replaces a part or all of germanium2Sb2Te5 that is phase change components by at least one of GeSb4Te7, GeSb2Te4, In3SbTe2, In35Sb32Te33, and In31Sb26Te43, and it transposes some or all of germanium to In.

[0294] (Other examples of a high-melting component) a part or all of Co3Si that is high-melting components -- Ce5Si3, Ce3Si2, Ce5Si4, CeSi, and Ce3 -- Si5, CeSi2, Cr5Si3, CrSi, CrSi3 and CrSi2, Cr3Si, CoSi, and CoSi2 and NiSi2 -- NiSi, nickel3Si2, nickel2Si, nickel5Si2, nickel3Si, Pt5Si2, Pt2Si, PtSi, LaSi2, Bi2Ce, BiCe, Bi3Ce4, Bi3Ce5, and BiCe2 and Cd11 -- Ce and Cd6 -- Ce and Cd58 -- Ce13 and Cd3 -- Ce and Cd -- 2 Ce CdCe, Ce2Pb, CePb, and CePb3 and Ce3 -- Sn and Ce5 -- Sn3 and Ce5 -- Sn4 and Ce11 -- Sn10 and Ce3 -- Sn5 and Ce3 -- Sn7 and Ce2 -- Sn5, CeSn3, CeZn, and CeZn2, CeZn3 and Ce3 -- Zn11 and Ce13 -- Zn58 and CeZn5 -- Ce3 -- Zn22 and Ce2 -- Zn17, CeZn11, Cd21Co5, CoGa, CoGa3, CoSn, Cr3Ga, CrGa, and Cr5 -- Ga6, CrGa4, Cu9Ga4, Cu3Sn, Cu3Zn, Bi2La, BiLa, and Bi3 -- La4 and Bi3 -- La5 and BiLa2 -- It LaZn(s). Cd11 -- La and Cd17 -- La2 and Cd9 -- La2 and Cd2 -- La, CdLa, Ga6La, Ga2La, GaLa, Ga3La5, and GaLa3 and La5 -- Pb3 and La4 -- Pb3, La11Pb10, La3Pb4, La5Pb4, and LaPb2 and LaPb3 -- LaZn2, LaZn4, LaZn5, La3Zn22, La2Zn17, LaZn11 and LaZn13, NiBi, Ga3nickel2, GaNi, and Ga2 -- nickel3 and Ga3 -- nickel5, GaNi3, nickel3Sn, nickel3Sn2, nickel3Sn4, NiZn, and nickel5Zn21 -- PtBi, and PtBi2, PtBi3, PtCd2 and Pt2 -- Cd9 and Ga7 -- Pt3 and Ga2 -- Pt and Ga3 -- Pt2, GaPt, Ga3Pt5, GaPt2 and GaPt3, Pt3Pb, PtPb, Pt2Pb3, Pt3Sn, PtSn, and Pt2 -- Sn3 and PtSn2 -- PtSn4 and Pt3 -- the same result is obtained even if it replaces the element expressed with said B, such as Zn and PtZn2, by at least one of the 3 yuan or more compounds near the things or these mixed presentations, and a mixed presentation of the presentation near the high-melting compound included two or more or it.

[0295] About the matter which has not been described here, it is the same as that of an example 1.

[0296] [Example 4]

(A configuration and process) Drawing 3 shows the cross-section structure of a disk-like information record medium where the thin film for information record of the 1st example of this invention was used. This medium was manufactured as follows.

[0297] First, the polycarbonate substrate 1 which has the tracking slot of a cross-section U typeface was formed in the front face by 1.2mm in the diameter of 13cm, and thickness. Next, in order to form a thin film one by one on this substrate 1, the substrate 1 was placed into the magnetron sputtering system. This equipment can have two or more targets, and can form a cascade screen one by one. Moreover, it excels in the homogeneity of thickness and repeatability which are formed.

[0298] With the magnetron sputtering system, the protective layer 2 which consists of 80% (SiO₂) and 20%, i.e., (Zn40S40Si 7013), the film, first (ZnS) on a substrate 1 was formed so that it might become about 130nm of thickness. Then, after forming in island shape Cr4Te5 film (not shown) which is a high-melting component to 3nm of average thickness on a protective layer 2, Cr9germanium7Sb27Te573, i.e., (GeSb4Te7) (8(Cr4Te5) 2), the record film of a presentation, was formed to about 22nm of thickness on it. Under the present circumstances, the rotation coincidence sputter by Cr4Te5 target and GeSb4Te7 target was used.

[0299] It is not necessary to necessarily form Cr4Te5 film. However, record membrane flow a little becomes easy to happen in that case. When not forming Cr4Te5 film, the high-melting component which deposits in record film 3 is produced in the case of initialization mentioned later.

[0300] Next, after forming the interlayer 4 who consists of 80 (ZnS) (SiO₂) 20 film to about 40nm thickness on record film 3, the reflecting layer 5 which consists of aluminum97Ti3 film within the sputtering system same on it was formed to 200nm of thickness. In this way, the 1st disk member was obtained.

[0301] On the other hand, the 2nd disk member with the same configuration as the 1st disk member was completely obtained by the same approach. The laminating of the 2nd disk member was carried out to order with a diameter [of 13cm], and a thickness of 1.2mm on substrate 1'. Protective layer 2' which consists of 80 (ZnS) (SiO₂) 20 film of about 130nm of thickness, Cr4Te5 film (not shown) of 3nm of average thickness, and Cr9germanium7Sb27Te57 of about 22nm of thickness -- namely, (GeSb4Te7) (8(Cr4Te5) 2), record film 3' -- thickness -- about -- 40 -- nm -- 80 (ZnS) (SiO₂) -- 20 -- the film -- becoming -- an interlayer -- four -- ' -- and -- thickness -- 200 -- nm -- aluminum -- 97 -- Ti -- three -- the film -- becoming -- a

reflecting layer -- five -- ' -- having -- **** .

[0302] Then, the disk-like information record medium which shows the reflecting layer 5 of said 1st and 2nd disk members and 5' to lamination and drawing 3 was obtained through the adhesives layer 6.

[0303] By this medium, when the whole surface of a reflecting layer 5 and 5' was pasted up, a rewritable count was able to be made [many] compared with the case where the whole surface is not pasted up and adhesives were not attached to a reflecting layer 5 and the part corresponding to the record section of 5', record sensibility became high for a while rather than the case where adhesives are attached also to that part.

[0304] (Initialization) It initialized as follows to the record film 3 of the medium which is the above, and was made and manufactured, and 3'. In addition, since the same is completely said of record film 3', in the following explanation, it considers as what only record film 3 is described for.

[0305] The medium was rotated by 1800rpm, the laser beam power of semiconductor laser (wavelength of 830nm) was maintained at the level (about 1mW) on which record is not performed, and the numerical aperture in a recording head (NA) condensed with the lens of 0.55, and irradiated the laser beam through the substrate 1 at record film 3. The reflected light from record film 3 was detected, and while performing tracking so that the core of a laser beam spot might always be in agreement in the middle of the core of the tracking slot of a substrate 1 or a slot, and a slot, the recording head was driven, performing automatic-focusing doubling so that the focus of a laser beam may come on record film 3.

[0306] First, the power 15mW continuation (DC) laser beam was irradiated 200 times on the same recording track of record film 5 for initialization. The irradiation time (optical spot pass time) of each time is about 0.1microsec.

[0307] Then, the power 7mW continuation laser beam was irradiated 5 times. The irradiation time (optical spot pass time) of each time is about 0.1microsec. What is necessary is for the range of the laser beam power at this time just to be 5-9mW.

[0308] It is better for an elimination property to irradiate, although the exposure with the lower power among said two kinds of laser beam exposures (7mW) may be omitted.

[0309] Thus, if the laser beam from which power differs is irradiated, it can fully initialize.

[0310] It is still more desirable if it carries out using the thing which performed these laser beam exposures using the semiconductor laser array, or divided the light beam from gas laser into plurality, or the thing which made the spot configuration of the light beam from high power gas laser or semiconductor laser the ellipse long to radial [of a medium]. If it carries out like this, it will also become possible to complete initial crystallization only by carrying out a small number of rotation of the medium.

[0311] If these laser beam spot is not arranged on the same recording track, but a location little by little and it is arranged to it when using two or more laser beam spots, it will disappear [which can initialize the large range by one exposure], and effectiveness, like the remainder decreases will be acquired. [radial / of a medium]

[0312] next, the 12mW continuation laser beam (high-power light for initialization) of a circular spot is irradiated once -- every (irradiation time: about 0.1microsec) -- power 15mW pulsed laser light (high-power light for record) was irradiated, record film 5 was made amorphous, and the recording point was formed. Then, in order to irradiate a 7mW continuation laser beam (low power light for elimination) and to crystallize the recording point, irradiating a 7mW continuation laser beam how many times investigated whether it was the need.

[0313] By the disk of this example, the count of said 7mW continuation laser beam exposure which crystallization takes fell, so that the count of an exposure increased [the count of an exposure of a 12mW continuation laser beam] to 100 times. That is, it turned out that it is easy to crystallize, so that the count of an exposure increases. This is guessed because much detailed crystals of Cr₄Te₅ which is a high-melting component deposited in record film 5 and the presentation of GeSb₄Te₇ which the presentation of the remainder (part which carries out a phase change) can crystallize [high-speed] was approached by the exposure of a 12mW continuation laser beam.

[0314] The signal A corresponding to the repeat of the record mark of 2T, and the tooth space between 8T on the other hand while shifting a location at random in 16T (1T are 45ns) in the beginning [signal writing] on a recording track supposing the signal of a mark edge recording method Since mark formation frequency changes a lot suddenly in the change part of Signal A and Signal B when the signal B corresponding to the repeat of the record mark of 8T and the tooth space between 2T records the signal repeated by turns If record film flows, since the record film ingredient which has flowed is stopped and it deposits, or a record film ingredient will flow out without the inflow from back and thickness will become thin, regenerative-signal waveform distortion arises. When the element in record film segregates, similarly, the element carries out an

opposite product, or runs short. If a flow and a segregation happen to some extent, according to the inclination of thickness or concentration, a reverse flow and a reverse segregation will also become easy to happen, and they will require a brake. Therefore, if a power (15mW) continuation light somewhat high width is repeated and is irradiated from the record section before use of a disk, change in the above record sections can be prevented to some extent. Therefore, magnitude of the waveform distortion by many times rewriting of the above-mentioned signal was made into the index for every disk, and it asked for the count of the repeat exposure need of the above-mentioned continuation light. As mentioned above, the larger one which are the count of the need of an exposure for a crystallization rate to become sufficiently large and the count of the need of an exposure for waveform distortion to become small is the count of the initialization need of the disk. The count of the need for a crystallization rate to become sufficiently large by the disk of this example was larger, and 100 times was a count of a need initialization exposure.

[0315] In addition, the melting point of Cr4Te5 is 1252-degreeC, and the melting point of GeSb4Te7 is 605-degreeC.

[0316] (Near [related 1:-GeSb4Te7] the germanium content a) The presentation was changed on straight-line ** which set constant Cr content which connects germanium65Te25Cr10 of the triangular phase diagram of drawing 10, and Sb30Te60Cr10, and the crystallization temperature of the non-recorded part at the time of carrying out a temperature up with constant speed and the count of laser radiation for initialization were measured. Consequently, the following data were obtained.

[0317]

A presentation Crystallization temperature Count of laser radiation Sb30Te60Cr10 120-degreeC 200 or less times germanium2Sb29Te59Cr10 130-degreeC 200 or less times germanium4Sb28Te58Cr10 150-degreeC 200 or less times germanium10Sb25Te55Cr10 160-degreeC 200 or less times germanium15Sb23Te52Cr10 170-degreeC 500 times germanium17Sb22Te51Cr10 170-degreeC 2000 times germanium25Sb18Te47Cr10 180-degreeC By 5000 times, in the range of $0.02 \leq a \leq 0.19$, suitable crystallization temperature is acquired and the count of laser radiation for initialization can be reduced from this result.

[0318] (Near [related 1:-GeSb4Te7] the Sb content b) The presentation was changed on straight-line ** which set constant Cr content which connects Sb45Te45Cr10 of the triangular phase diagram of drawing 10, and germanium18Te72Cr10, and the crystallization temperature at the time of carrying out a temperature up with constant speed and the count of laser radiation for initialization were measured. Consequently, the following data were obtained.

[0319]

A presentation Crystallization temperature Count of laser radiation germanium17Sb2Te71Cr10 210-degreeC 5000 times germanium17Sb4Te69Cr10 200-degreeC 1000 times germanium14Sb10Te66Cr10 180-degreeC 500 times germanium10Sb20Te60Cr10 170-degreeC 200 or less times germanium7Sb26Te57Cr10 160-degreeC 200 or less times germanium5Sb33Te52Cr10 150-degreeC 200 or less times germanium3Sb36Te51Cr10 200 or less 140-degreeC germanium2Sb40Te48Cr10 From this result, it sets in the range of $0.04 \leq b \leq 0.4$ 200 or less 120-degreeC. Suitable crystallization temperature is acquired and the number of laser radiation ** times for initialization can be reduced.

[0320] A presentation is changed on straight-line ** which set constant Cr content which connects Sb15Te75Cr10 of the triangular phase diagram of drawing 10, and germanium30Sb60Cr10. (Near [related 1:-GeSb4Te7] the Te content c) The irradiation time of a laser beam required for elimination of the information currently recorded and change of the carrier-to-noise ratio (C/N) of the regenerative signal after rewriting laser beam power 105 times on the severe conditions made higher 15% than an optimum value were measured. Consequently, the following data were obtained.

[0321]

After rewriting 105 times A presentation Laser beam irradiation time C/N of a regenerative signal germanium14Sb36Te40Cr10 0.5microsec 44dB germanium12Sb33Te45Cr10 0.2microsec 48dB germanium11Sb31Te48Cr10 0.1microsec 50dB germanium8Sb27Te55Cr10 0.1microsec 50dB germanium5Sb22Te63Cr10 0.5microsec 50dB germanium3Sb19.5Te67.5Cr10 1.0microsec 50dB Sb15Te75Cr10 3.0microsec From this result, 50dB is set in the range of $0.5 \leq c \leq 0.75$. Irradiation time of a laser beam required for elimination can be lessened, and the carrier-to-noise ratio (C/N) of the regenerative signal after rewriting 105 times on the severe conditions which made laser beam power higher 15% than an optimum value can improve.

[0322] When keeping the ratio of the contents a, b, and c of the germanium pair Sb pair Te which are the remainders of Cr4Te5 at a:b:c=1:4:7 and changing the content of Cr4Te5, (Near [related 1:-GeSb4Te7] the Cr content d) When C/N of the regenerative signal after rewriting the power of a laser beam 105 times on the severe conditions made higher 15% than an optimum value was measured, the following results were

obtained about the content d of Cr.

[0323]

Regenerative-signal C/N after 105 times rewriting d= 0 42dB d= 3 48dB d= 10 50dB d= 20 50dB d= 34 When the content d of 48dB Cr was changed, the "elimination ratio" of the regenerative signal when the over-write [a signal] after 1-time record once changed as follows, having used the count of initialization as 200 times on the severe conditions which made power of a laser beam higher 15% than an optimum value.

[0324] An "elimination ratio" expresses the ratio of the signal before and behind overwrite when carrying out overwrite of another signal with which frequencies differ on the already recorded signal with dB here.

[0325]

The over-write [a signal] after 1-time record once The elimination ratio of the regenerative signal when carrying out d= 10 28dB d= 20 25dB d= 30 25dB d= 40 From this result, 20dB is understood that an elimination ratio falls as the content d of Cr increases.

[0326] From this result, in the range of $0.03 \leq d \leq 0.3$, irradiation time of a laser beam required for elimination can be lessened, and the carrier-to-noise ratio (C/N) of the regenerative signal after rewriting 105 times on the severe conditions which made laser beam power higher 15% than an optimum value can improve.

[0327] When the high-melting component H of an element simple substance, the low-melt point point component L of a compound presentation and an element simple substance, or a compound presentation expressed the average presentation of the thin film for record by the formula of $LjHk$ and the content k was changed, C/N of the regenerative signal after rewrite crystallization temperature and laser power 105 times on the severe conditions made high 15% changed as follows.

[0328]

After rewriting 105 times Group ** C/N of a regenerative signal Crystallization temperature (GeSb4Te7) 95 (Cr4Te5) 5 45dB 170 degree-C(GeSb4Te7) 90 (Cr4Te5) 10 48dB 170 degree-C(GeSb4Te7) 80 (Cr4Te5) 20 50dB 160 degree-C(GeSb4Te7) 65 (Cr4Te5) 35 50dB 150 degree-C(GeSb4Te7) 50 (Cr4Te5) 50 50dB 130 degree-C(GeSb4Te7) 40 (Cr4Te5) 60 49dB 120 degrees C was understood that the range of $20 \leq k/(j+k) \leq 40$ is more desirable than this result.

[0329] (Relation with the high-melting component made to cover at the time of membrane formation) When manufacturing the thin film for information record of this example, high-melting component Cr4Te5 was made to put at an early process, but when the average thickness z of that high-melting component Cr4Te5 was changed as follows, C/N of the regenerative signal after rewriting a rewritable count and the power of a laser beam 105 times on the severe conditions made higher 15% than an optimum value changed as follows. Change of this C/N is based mainly on change of C level.

[0330]

A rewritable count z= 0nm 5x104 times z= 1nm 1x105 times z= 5nm 2x105 times C/N of the regenerative signal after 105 times rewriting z= 1nm 47dB z= 5nm 47dB z= 10nm 46dB It turned out that the range of 1 nm $\leq z \leq 10$ nm is more desirable than this result z= 20nm40 dB.

[0331] (In addition to this a protective layer, an interlayer, and the reflecting layer quality of the material) Although the protective layer 2 and the interlayer 4 are formed by ZnS-SiO₂ in this example It replaces with ZnS-SiO₂. A Si-N system ingredient, a Si-O-N system ingredient, SiO₂, SiO, TiO₂ and Ta 2O₅, aluminum2O₃, Y2O₃, CeO and La 2O₃, In2O₃, GeO, GeO₂, PbO, SnO, SnO₂ and Bi 2O₃, TeO₂, WO₂, WO₃, Sc 2O₃, Nitrides, such as oxides, such as ZrO₂, TaN and AlN, Si₃N₄, and an aluminum-Si-N system ingredient (for example, AlSiN₂), Sulfides, such as ZnS, Sb₂S₃, CdS, In₂S₃, Ga₂S₃, GeS, SnS₂ and PbS, and Bi₂S₃; Selenides, such as SnSe₂, Sb₂Se₃, CdSe, ZnSe, In₂Se₃, Ga₂Se₃, GeSe, GeSe₂, SnSe, PbSe, and Bi₂Se₃; Fluorides, such as CeF₃, MgF₂, and CaF₂, or Si, germanium and TiB₂, B₄C, B, and C, or the thing of the presentation near the above-mentioned ingredient may be used. Moreover, the layers and these multiplex layers of these charges of an admixture are sufficient.

[0332] the case of a multiplex layer -- ZnS -- more than 70 mol % -- the oxide of the included ingredient, 80 (SiO₂) 20 [for example, (ZnS),], Si and the ingredient which contains at least 1 person of the germanium more than 70 atom %, for example, Si, or Si, for example, the two-layer film with SiO₂, is desirable. In this case, in order to prevent a record sensibility fall, ZnS-SiO two-layer is prepared in a record film side, and that thickness is set to 3nm or more. Moreover, in order to demonstrate the record membrane flow depressor effect by the low-temperature expansion coefficient of layers, such as SiO₂, 10nm or less in thickness is desirable. Although this two-layer film is desirable when it is prepared instead of a protective layer 2, you may prepare instead of an interlayer 4. As a substitute of a protective layer 2, 50nm or more 250nm or less has the desirable thickness of layers, such as SiO₂. When preparing the two-layer film instead of an interlayer, SiO two-layer thickness has 10nm or more desirable 80nm or less. It is desirable to prepare these two-layer film, not only when using the record film of this invention but when using other phase change record film.

[0333] Moreover, since the degree of freedom of reflection factor decision will increase if it is made the two-layer film which prepared Au layer in the ZnS-SiO₂ and substrate side, it is desirable. The thickness of Au layer at this time has desirable 30nm or less. The charge of an admixture which uses Au(s), such as Au-Co, Au-Cr, Au-Ti, Au-nickel, and Au-Ag, as a principal component instead of Au may be used.

[0334] the case where an interlayer 4 is omitted -- record sensibility -- about 30% -- falling -- also remaining unmelted -- it increased about 5dB. The rewritable count also decreased.

[0335] When an interlayer's 4 refractive index was in 1.7 or more and 2.3 or less range, C/N 50dB or more was obtained for thickness, respectively in the range of 3nm or more and 100nm or less and 180nm or more, and 400nm or less.

[0336] Instead of aluminum-Ti used for the reflecting layer 5 in this example, as an ingredient of a reflecting layer, since the charge of a Si-germanium admixture can make the rate of light absorption of a record mark part smaller than the rate of light absorption of parts other than a record mark, it is based on an optical absorption coefficient difference, and disappears, the remainder can be prevented, and a rewritable count does not fall further. Below in 80 atom %, a fall cannot produce [a rewritable count] the content of germanium easily more than 10 atom %.

[0337] Subsequently, the result with the same said of two or more sorts of charges of an admixture of Si-Sn, the charge of a Si-In admixture, or the charge of these admixtures was obtained. Even if it uses these reflecting layer ingredients as a reflecting layer ingredient in the case of using not only the phase change film of this invention but other phase change film, a rewritable count does not fall compared with the conventional reflecting layer ingredient.

[0338] Furthermore, the element simple substance of Si, germanium, C, Au, Ag, Cu, aluminum, nickel, Fe, Co, Cr, Ti, Pd, Pt, W, Ta, Mo, and Sb, Or the layer which consists of an alloy which makes these a principal component, or these comrades' alloy may be used, the multiplex layer which consists of those layers may be used, and the compound layer of these and other matter, such as an oxide, etc. may be used.

[0339] In this example, directly, although the polycarbonate substrate 1 in which the irregularity of a tracking guide etc. was formed is used for the front face instead, the chemically strengthened glass in which polyolefine, epoxy, acrylic resin, and a UV-cured resin layer were formed on the front face etc. may be used for it.

[0340] Even if the configuration of the simple laminated structure 3 which omitted a part of interlayer 4, reflecting layer 5, and protective layer 2, for example, the 2/record film of 1/protective layers of substrates, the 3/interlayer 4 of 1/record film of substrates, the 3/reflecting layer 5 of 1/record film of substrates, etc. also rewrote many times compared with the conventional thing, the noise rise had it, and the good result was obtained. [little]

[0341] As stated above, many rewritings are more possible for the thin film for information record of this example than before, keeping good record and playback / elimination property. Moreover, there is also an advantage that the power of the laser beam used for record and elimination may be low.

[0342] In addition, the matter which has not been described here is the same as an example 1.

[0343] [Example 5] In the record film 5 of the germanium-Sb-Te-Cr system of an example 1, record film 5 was formed by presentation germanium40Sb10Te40Cr10 near germanium50Te50 presentation. 20nm and record film were formed for 15nm and a protective layer, and structure formed [the metal layer] 40nm and 70nm of reflecting layers in the bottom which is a protective layer for 20nm and an interlayer. The ingredient used Au for the metal layer and the reflecting layer. The thin film for information record was produced like the example 1 except it. Moreover, it was presupposed that the record playback approach of initialization of the thin film concerned and the information on subsequent is the same as that of an example.

[0344] (Near the related -2:GeTe presentation with the Sb content b) The presentation was changed on straight-line ** which set constant Cr content which connects germanium45Te45Cr10 of the triangular phase diagram of drawing 11, and Sb90Cr10, and the reflection factor difference at the time of making it crystallize with the time of making it make it amorphous was measured. Consequently, the following data were obtained.

[0345]

組成	反射率差
Ge ₄₅ Te ₄₅ Cr ₁₀	5 0 %
Ge ₄₃ Sb ₄ Te ₄₃ Cr ₁₀	5 1 %
Ge ₄₀ Sb ₁₀ Te ₄₀ Cr ₁₀	5 1 %
Ge ₃₇ Sb ₁₆ Te ₃₇ Cr ₁₀	4 4 %
Ge ₃₅ Sb ₂₀ Te ₃₅ Cr ₁₀	3 0 %

This showed that a high reflection factor difference was acquired in $0 \leq b \leq 0.2$ in near a GeTe presentation. When Sb was added in $0.01 \leq b \leq 0.2$, the crack initiation in 80% of 60 relative humidity has been prevented. However, presentation control finer than the film which does not add Sb is required.

[0346] (germanium, near the related -2:GeTe presentation with the Te contents a and c) The presentation was changed on straight-line ** which set constant Cr content which connects Sb10Te80Cr10 of the triangular phase diagram of drawing 11, and germanium80Sb10Cr10, and the reflection factor difference at the time of making it crystallize with the time of making it make it amorphous was measured. Consequently, the following data were obtained.

[0347]

組成	反射率差
Ge ₁₅ Sb ₁₀ Te ₆₅ Cr ₁₀	3 5 %
Ge ₂₀ Sb ₁₀ Te ₆₀ Cr ₁₀	4 5 %
Ge ₂₈ Sb ₁₀ Te ₅₂ Cr ₁₀	5 0 %
Ge ₄₀ Sb ₁₀ Te ₄₀ Cr ₁₀	5 1 %
Ge ₅₂ Sb ₁₀ Te ₂₈ Cr ₁₀	4 6 %
Ge ₆₀ Sb ₁₀ Te ₂₀ Cr ₁₀	3 6 %

This showed that a high reflection factor difference was acquired in $0.25 \leq a \leq 0.65$ and $0.35 \leq c \leq 0.75$ in near a GeTe presentation.

[0348] When keeping the ratio of the contents a, b, and c of the germanium pair Sb pair Te which are the remainders of Cr4Te5 at a:b:c=4:1:4 and changing the content of Cr4Te5, (Near the related -2:GeTe presentation with the Cr content d) When C/N of the regenerative signal after rewriting the power of a laser beam 105 times on the severe conditions made higher 15% than an optimum value was measured, the following results were obtained about the content d of Cr.

[0349]

Regenerative-signal C/N after 105 times rewriting d= 0 42dB d= 3 48dB d= 10 50dB d= 20 50dB d= 34 When the content d of 48dB Cr was changed, the "elimination ratio" of the regenerative signal when the over-write [a signal] after 1-time record once changed as follows, having used the count of initialization as 200 times on the severe conditions which made power of a laser beam higher 15% than an optimum value.

[0350] An "elimination ratio" expresses the ratio of the signal before and behind overwrite when carrying out overwrite of another signal with which frequencies differ on the already recorded signal with dB here.

[0351]

The over-write [a signal] after 1-time record once The elimination ratio of the regenerative signal when carrying out d= 10 28dB d= 20 25dB d= 30 25dB d= 40 From this result, 20dB is understood that an elimination ratio falls as the content d of Cr increases.

[0352] From this result, in the range of $0.03 \leq d \leq 0.3$, a sufficiently high elimination ratio is obtained and the carrier-to-noise ratio (C/N) of the regenerative signal after rewriting 105 times on the severe conditions which made laser beam power higher 15% than an optimum value can improve.

[0353] In addition, the matter which has not been described here is the same as an example 1.

[0354] [Example 6] In the record film 5 of an example 1, the thin film for information record was produced like the example 1 except the point that said high-melting component formed the record film which changed in the direction of thickness. Moreover, others were produced like the disk-like information record medium which one example used. Initialization and the subsequent record / playback approach were also made to be the same as that of an example 1.

[0355] (A configuration and process) The content of said high-melting component used the rotation coincidence spatter of the Cr4Te5 target and GeSb4Te7 target by the magnetron sputtering system for formation of the record film which changed in the direction of thickness. Under the present circumstances, 3nm of Cr4Te5 film is formed first, as shown below after that, the electrical potential difference impressed to GeSb4Te7 target was fixed, and the electrical potential difference impressed to Cr4Te5 target was lowered gradually.

[0356]

Spatter time amount Spatter power (W) From an optical incidence side Cr4Te5 content (second) GeSb4Te7 target Cr4Te5 target Record film thickness (nm) (atomic %) 0-9 49 150 0-6 5010-20 49 100 6-12 4021-33 49 65 13-18 3034-47 49 40 19-24 2048-63 49 20 24-30 The electrical potential difference impressed to Cr4Te5 target is fixed, and even if it raises gradually the electrical potential difference impressed to GeSb4Te7 target, the content of a high-melting component can form also in 10 others the record film which changed in the direction of thickness. Made it better [the recording characteristic] for applied voltage to change

gradually. Moreover, in in-line spatter equipment, the specification of the target to which the area of Cr4Te5 presentation and the area of GeSb4Te7 presentation were changed gradually is carried out, and it can be produced similarly. The disk with this record film was produced.

[0357] This disk has reduced the count of laser radiation for initialization, although production became complicated compared with record film with the content of a high-melting component fixed in the direction of thickness like an example 1.

[0358] About the matter which has not been described here, it is the same as that of an example 1.

[0359] [Example 7] Drawing 12 shows an example of the structure section Fig. of the disk using the super resolution read-out film by this invention.

[0360] In manufacture of the disk of drawing 12, the polycarbonate substrate 11 with which information was recorded with irregularity with a diameter [of 13cm] and a thickness of 1.2mm was formed first. Next, it had two or more targets for this substrate, and the cascade screen could be formed one by one, and it attached in the magnetron sputtering system with the sufficient homogeneity of thickness and repeatability, and 80 (ZnS) (SiO2) 20 layer 12 [with a thickness of 125nm] was formed on this substrate. Then, it is GeSb2Te4 at an RF generator about Cr4Te5 target. The coincidence spatter of the target was carried out by DC power supply, and 30nm of 20 (GeSb2Te4) 80 film 13 which is super resolution read-out film (Cr4Te5) was formed. Next (ZnS), they are 20nm and aluminum97Ti3 about 80 (SiO2) 20 layer 14. The laminating of the layer 15 was carried out to 100nm thickness one by one. Then, polycarbonate substrate 11' was stuck and united through the glue line 16 on this.

[0361] Generally, if light is irradiated at a thin film, interference will arise by the superposition of the reflected light from the front face of a thin film, and the reflected light from the rear face of a thin film. Then, effectiveness of interference can be enlarged by preparing the "reflecting layer" which approaches a thin film and reflects light to enlarge change of the reflection factor of the thin film for super resolution read-out. In addition, it is good also as an absorption layer which absorbs light. aluminum97Ti3 of drawing 1 A layer 15 plays the role of this reflecting layer.

[0362] In order to enlarge effectiveness of interference more, it is desirable to prepare an "interlayer" between the thin film for super resolution read-out and a reflecting layer. An interlayer has the work which decreases the recess of the operation which prevents that counter diffusion happens between the thin film for super resolution read-out, and a reflecting layer, and the heat to a reflecting layer, it reads [work] at the time of super resolution read-out, and sensibility is raised [work], and crystallizes the film after super resolution read-out. 80 (ZnS) (SiO2) 20 layer 14 of drawing 12 carries out this interlayer's operation.

[0363] As for one [at least] interface of said thin film 13 for super resolution read-out, it is desirable to stick to other matter and to be protected, and if the interface of both sides is protected, it is still more desirable. A substrate may perform this protection and the protective layer formed apart from the substrate may perform. By formation of a "protective layer", the increment in a noise resulting from deformation of the thin film at the time of super resolution read-out can be prevented. 80 (ZnS) (SiO2) 20 layer 12 of drawing 12 carries out an operation of this protective layer.

[0364] The thickness of the super resolution read-out film 13 was determined from the measurement result of the reflection factor of a crystallization condition and an amorphous state shown in drawing 13. As shown in drawing 2, when thickness was 30nm, the reflection factor of a crystallization condition was larger than the amorphous state, and since the reflection factor difference of a crystallization condition and an amorphous state became max, the thickness of 20 (Cr4Te5) (GeSb2Te4) 80 film 13 was set as 30nm.

[0365] The disk produced as mentioned above initialized as follows first. With flash plate light, after perform preliminary crystallization, the disk was rotated by 1800rpm, it maintained at the level (about 1mW) on which super resolution read-out is not perform, it condensed with the lens in a recording head, the optical reinforcement of semiconductor laser was read through the substrate 11, the film 13 was irradiated, and by detect a reflection factor, the head was drove so that the core of an optical spot might always be in agreement with the core of the slot for tracking. Thus, performing tracking, automatic-focusing doubling was performed so that a focus might suit on the super resolution read-out film further, and the power 11mW continuation laser beam was first irradiated 5 times on the same truck for initial crystallization. This exposure power is good in 9-18mW. Then, the 6mW continuation laser beam was irradiated 3 times. This exposure power is good in 4-9mW. Although the two above-mentioned kinds of exposures should just be 1 time or more, the exposure of the one where power is higher has 2 more desirable times or more.

[0366] In order to improve C/N by the super resolution read-out film containing a high-melting component, it is important to fully perform initial crystallization. For this reason, initial crystallization performed the exposure by low power preponderantly, and irradiated the power 6mW continuation laser beam 500 times and irradiated the 6mW continuation laser beam to the 11mW continuation laser beam 10 times 3 times

continuously on the same truck. Although time amount was taken, when 11mW three laser radiation was repeated several times, C/N and the count which can be super resolution read increased further by 6mW 500 times.

[0367] If it carries out with the thing which performed these exposures by the semiconductor laser array, or divided the light beam from gas laser into plurality, or the ellipse beam which operated the light beam from high power gas laser or semiconductor laser orthopedically for a long time to radial [of a disk], it is also possible to carry out to coincidence to all trucks by one rotation of a disk. If two or more optical spots are not arranged on the same truck but a little location is shifted and arranged in the method line of a radius of a disk, the large range can be initialized, it disappears and there is effectiveness, like the remainder decreases.

[0368] Moreover, when the truck periphery also crystallized by the approach of irradiating a continuation laser beam, performing tracking between slots at the last of initialization, the cross talk was able to be reduced by 2dB. In crystallization, power was set to 6mW and continuation light was irradiated.

[0369] The principle of super resolution read-out by the super resolution effectiveness is as follows. In drawing 8, they are optical spots, such as a laser beam, and the record mark by which 31 was formed in 32a and 32b was formed in the front face of a substrate 1. The diameter of an optical spot is defined as a diameter of the light beam in the location where optical reinforcement becomes (1 / e2) of the peak intensity. The minimum pitch of a record mark is set up smaller than the diameter of a spot of the optical spot 31.

[0370] In the elevated-temperature field in an optical spot, in order [in the super resolution read-out film] for phase change component GeSb2Te4 to dissolve at least and for either [at least] the real part n of complex index of refraction or the imaginary part k to fall, decline in a reflection factor takes place. Then, although there are two record marks 32a and 32b in the optical spot 31, since record mark 32b in the elevated-temperature field 35 is hidden by the super resolution read-out layer 13, only record mark 32a is detected in fact. If it puts in another way, the actual detection range 34 will serve as the range 33 31 committed as a mask, i.e., an optical spot, and a crescent shape field excluding the duplication part of the elevated-temperature field 35 from the circular field of the optical spot 31 like drawing 8. In this way, it becomes possible to carry out super resolution read-out of the record mark smaller than the diameter of an optical spot.

[0371] In the part which performs super resolution read-out, laser power was set to 8mW, it was kept constant, and super resolution read-out was performed. This power changes with melting points of the super resolution read-out film. When passing the super resolution read-out part, laser power was lowered to 1mW and tracking and automatic-focusing doubling were continued. Lowering laser power to 1mW had effectiveness in preventing degradation of a mask layer. In addition, tracking and automatic-focusing doubling are continued also during super resolution read-out. Within limits the relation between tracking and the laser power Pt for automatic-focusing doubling, and the laser power Pr for super resolution read-out is indicated to be to a degree type, the good super resolution read-out property was acquired.

[0372] By the disk which is left with the super resolution read-out film making amorphous, it needed to crystallize after $Pr/Pt \geq 2$ super-resolution read-out. About the disk of the film presentation crystallized again, crystallization was unnecessary after read-out.

[0373] by the disk using the super resolution read-out film of this example, and the disk which does not use the super resolution read-out film, when C/N at the time of carrying out super resolution reading appearance of the mark of different size was compared, in the disk using the super resolution read-out film of this example, the super resolution effectiveness of a minute mark was seen as follows.

[0374]

Mark size (micrometer) Super resolution read-out Super resolution read-out Those with the film (dB) With no film (dB)

----- 0.3 30 - 0.4 43 30 0.5 47 35 0.6 49 40 0.7 50 46 0.8 50 50 protective coats, ZnS-SiO₂ used for at least 1 person of the interlayers To ******, a Si-N system ingredient, a Si-O-N system ingredient, SiO₂, SiO, TiO₂ and aluminum 2O₃, Y2O₃, CeO, La 2O₃, In2O₃, GeO, GeO₂, PbO, SnO, SnO₂ and Bi 2O₃, TeO₂, WO₂, WO₃, Sc 2O₃, Oxides and nitrides, such as ZrO₂, and TaN, AlN, AlSiN₂, Si3N₄, [such as an aluminum-Si-N system ingredient] Sulfides, such as ZnS, Sb₂S₃, CdS, In₂S₃, Ga₂S₃, GeS, SnS₂ and PbS, and Bi₂S₃, The selenide of SnSe₂, Sb₂Se₃, CdSe, ZnSe, In₂Se₃, Ga₂Se₃, GeSe, GeSe₂, SnSe, and PbSeBi₂Se₃ grade, The thing of the presentation near fluorides, such as CeF₃, MgF₂, and CaF₂, or Si, germanium and TiB₂, B4 C, B, and C, or all the charges of protective coat material that were stated here may be used. Moreover, it can form with fluororesins, such as acrylic resin, a polycarbonate, polyolefine, an epoxy resin, polyimide, polystyrene, polyethylene, polyethylene terephthalate, and Pori ethylene tetrafluoride (Teflon), etc. The ethylene-vinylacetate copolymer known as hot melt adhesive, adhesives, etc. may be used. At least one of the resin of these may be formed with the ultraviolet-rays hardening resin used as a principal

component. You may serve as a protective layer with the substrate of the organic substance. Or these mixed ingredient layers or a multiplex layer is sufficient. When an interlayer was omitted, super resolution read-out sensibility fell about 30%, and the count which can be super resolution read also decreased. An interlayer's refractive index is or more 1.7 2.3 or less range, and, as for thickness, C/N 48dB or more was obtained in [3nm or more] 400nm or less.

[0375] The compound layer of the layer of the simple substance Au, Ag, Cu, C, Si, germanium, aluminum, nickel, Fe, Co, Cr, Ti, Pd, Pt, W, Ta, Mo, and Sb's or the alloy which makes these a principal component, a compound, mixture, or these comrades' alloy or a multiplex layer, these, and other matter, such as an oxide, etc. may be used instead of aluminum-Ti used for the reflecting layer.

[0376] Instead of the polycarbonate substrate which formed the irregularity of a direct tracking guide etc. in the front face as a substrate, the chemically strengthened glass in which polyolefine, epoxy, acrylic resin, and a UV-cured resin layer were formed on the front face etc. may be used.

[0377] In addition, although the disk using the super resolution read-out film shown in drawing 13 is one side structure, it is good also as double-sided structure which produces the two same structures as 11 to 15 instead of polycarbonate substrate 11', and was stuck through the glue line 6.

[0378] [Example 8] In the disk shown in drawing 1, when the presentation of the super resolution read-out film was changed as follows, variation $**k'$ of the extinction coefficient k of the super resolution read-out film before and after the exposure of a laser beam changed. the disk equipped with these super resolution read-out film -- the record mark of about 25% of die length of the diameter of an optical spot -- forming -- it -- 105 When C/N of the regenerative signal after carrying out time super resolution reading appearance was compared, the result as shown below was obtained.

[0379]

Film Group ** Variation of an extinction coefficient k 105 After time super resolution read-out C/N of
***** (Cr4Te5) 80(GeSb2Te4) 20 $**k'=5\%$ 37dB (Cr4Te5)
60 (GeSb2Te4) 40 $**k'=10\%$ 42dB (Cr4Te5) 40 (GeSb2Te4) 60 $**k'=20\%$ 46dB (Cr4Te5) 20(GeSb2Te4) 80
 $**k'=30\%$ 48dB is understood that the range of $20\% < **k'$ is more desirable than this result.

[0380] [Example 9] When the high-melting component was put into the super resolution read-out film, the count which can be super resolution read improved. The difference in the count by the difference (melting point of the melting point-phase change component of a Δ $m.p$ = high-melting component) of the melting point in the super resolution read-out film at this time which can be super resolution read was investigated. Here, a phase change component is GeSb2Te4. It used and the high-melting component was changed.

[0381]

High-melting component Δ $m.p$ (degree C) Count which can be super resolution read (time)
Pt3Sb 50 5x105 Mo3Sb7 150 1x106 CoSb3 200 2x106 Cr4Te5

$>=300$ It turns out are [$>=2x$] 106, consequently that the range of Δ $m.p>=150$ is desirable more.

[0382] [Example 10] It sets on the super resolution readout film indicated in the example 7, and is GeSb2Te4. As a phase change component of an except The same result is obtained even if it replaces among following D groups by at least 1 person of the 3 yuan or more compounds near the things or these mixed presentations, and a mixed presentation of the presentation near the presentation near at least 1 person or this, a compound with a melting point of 650 degrees C or less, or it.

[0383] <D group> Sn, Pb, Sb, Te, Zn, Cd, Se, In, Ga, S, Ti, Mg, Ti2Se, TiSe, Ti2Se3, Ti3Te2, TiTe, InBi, In2Bi, TeBi, Ti-Se, Ti-Te, Pb-Sn, Bi-Sn, Se-Te, S-Se, Bi-Ga, Sn-Zn, Ga-Sn, Ga-In, and In3SeTe2, AgInTe2, GeSb4Te7, germanium2Sb2Te5, GeSb2Te4, GeBi4Te7, GeBi2Te4, germanium3Bi2Te6, Sn2Sb6Se11, Sn2Sb2Se5, SnSb2Te4, and Pb2Sb6 -- Te11, CuAsSe2, Cu3AsSe3, CuSbS2, CuSbSe2, InSe, Sb2Se3, Sb2Te3, Bi2Te3, SnSb, FeTe, and Fe2Te3 -- FeTe2, ZnSb, Zn3Sb2, VTe2, V5Te8, AgIn2, BiSe, InSb, In2Te, In2Te5, Ba4Ti, Cd11Nd, Ba13Ti, Cd6Nd, Ba2Ti.

[0384] Cr4Te5 The same result is obtained even if it replaces by at least 1 person of the 3 yuan or more compounds near the things or these mixed presentations, and a mixed presentation of the presentation near the following compound, an alloy, or it as a high-melting component of an except.

[0385] (a) When the melting point of a phase change component is 450-650 degrees C, they are the compound of following A group, or a compound with a melting point of 800 degrees C or more.

[0386] The <A groups> 2, NdPd3, NdPd5, Nd7Pt3, Nd3Pt2, NdPt, Nd3Pt4, NdPt2, NdPt5, Bi2Nd, BiNd, Bi3Nd4, Bi3Nd5, BiNd2, Cd2Nd, [BaPd, BaPd /5 /, and NdPd] CdNd, Mn2Nd, Mn23Nd6, Mn12Nd, Nd5Sb3, Nd4Sb3, NdSb, NdSb2, Fe2Nd, Fe17Nd2, Cs3germanium2, CsGe, CsGe4, Nd5Si3, Nd5Si4, NdSi, and Nd3Si4, Nd2 -- Si3 and Nd5 -- Si9 and Cs2 -- Te, NdTe3, Nd2Te5, NdTe2, Nd4Te7, Nd2Te3, Nd3Te4, NdTe, and Ce3 -- Ir, Ce2Ir, Ce55Ir45, CeIr2 and CeIr3, Ce2Ir7, and CeIr5 -- CaPd, CaPd2, CaGe, and calcium2 -- germanium, GeNa3, GeNa, CaSi2, calcium2Si, CaSi, Se2Sr, Se3Sr2, SeSr, GeSr2, GeSr, germanium2Sr, SnSr, Sn3Sr5,

SnSr₂, and Ce -- 2 Ti Ce₅Ti₃, CeTi₃, Ce₃Ti₅, CeTi, BaTi, Pd₁₃Ti₉, and Pd₂ -- Ti and Pd₃ -- Ti and Mg₂ -- Si and Mg₂ -- germanium, BaPd₂, BaPd₅, Ce₄Se₇, Ce₃Se₄, Ce₂Se₃, CeSe, and Ce₅germanium₃ -- Ce₄germanium₃, Ce₅germanium₄, CeGe, Ce₃germanium₅, Ce₅Si₃, Ce₃Si₂, Ce₅Si₄, CeSi, Ce₃Si₅, CeSi₂ and CeTe₃, Ce₂Te₅, CeTe₂, Ce₄Te₇, Ce₃Te₄, CeTe, La₃Se₇, LaSe₂, La₄Se₇, La₂Se₃, La₃Se₄, LaSe, GeLa₃, germanium₃La₅, germanium₃La₄, germanium₄La₅, GeLa, germanium₅La₃, BaSe₂, Ba₂Se₃, BaSe, PdSe, and Mo₃Se₄, MoSe₂ and Ba₂ -- germanium, BaGe₂, BaGe, Ba₂Te₃, BaTe, and germanium₂ -- Pd₅, GePd₂, germanium₉Pd₂₅, GePd, germanium₃Pt, germanium₃Pt₂, GePt, germanium₂Pt₃, GePt₂, GePt₃, Pu₃Sn, and Pu₅Sn₃ -- Pu₅Sn₄, Pu₈Sn₇, Pu₇Sn₈, PuSn₂, PuSn₃, Pt₅Te₄, Pt₄Te₅, PtTe₂, GeNi, germanium₃nickel₅, germanium₂nickel₅, GeNi₃, NiTe 0.85, NiTe 0.775, and nickel₃*_xTex, Cr₁₁germanium₁₉, CrGe, Cr₁₁germanium₈, Cr₅germanium₃, and Cr₃ -- germanium, CrSi₂, Cr₅Si₃, Cr₃Si, Cr₅Te₈, Cr₄Te₅, Cr₃Te₄, Cr₁-_xTe, germanium₃Mn₅, GeMn₂, Mn₆Si, and Mn₉Si₂ -- Mn₃Si, Mn₅Si₂, Mn₅Si₃, MnSi, Mn₁₁Si₁₉, Mn₂Sn, Mn_{3.25}Sn, MnTe, Te₂W, FeGe₂, Fe₅germanium₃, Fe₃germanium, Fe₂Si, Fe₅Si₃, FeSi, FeSi₂, germanium₂Mo, germanium₄Mo₂₃, germanium₁₆Mo₉, germanium₂₃Mo₁₃, germanium₃Mo₅, GeMo₃, Mo₃Si, Mo₅Si₃, MoSi₂, MoSn, MoSn₂, and Mo₃ -- Te₄, MoTe₂, Si₂Ti, SiTi, Si₄Ti₅, Si₃Ti₅, and SiTi₃ -- Sn₅Ti₆, Sn₃Ti₅, SnTi₂, SnTi₃, CoGe₂, Co₅germanium₇, CoGe, Co₅germanium₃, Co₄germanium, Co₃Te₄, germanium₇Re₃, Re₅Si₃, ReSi, ReSi₂, Re₂Te.

[0387] (b) When the melting point of a phase change component is 250--450 degrees C, they are the compound of said A group or following B group, or a compound with a melting point of 600 degrees C or more.

[0388] the <B group> Cs₃ -- germanium and Ba₂ -- Ti, GePd₃, Fe₆germanium₅, FeTe₂, Co₅germanium₂, Nd₃Pd, Cs₃Te₂, Ce₄Ir, NaPd, calcium₉Pd, calcium₃Pd₂, and calcium₂ -- germanium and Se₃ -- Sr and Ce₃ -- Ti, CeSe₂, and Ce -- 3 germanium BaSe₃, GeSe₂, GeSe, BaTe₂, GePd₅, and germanium₈ -- Mn₁₁, MnTe₂, germanium₃W₂, FeGe, Fe₄germanium₃, Fe₃Sn, Fe₃Sn₂, FeSn, and CoTe₂.

[0389] (c) When the melting point of a phase change component is 250 degrees C or less, they are the compound of said A group, B group, or following C group, or a compound with a melting point of 400 degrees C or more.

[0390] <C group> Ba₄Ti, CsTe, Ba₄Ti, Ba₁₃Ti, Cd₁₁Nd, Cd₆Nd, Cs₅Te₄, calcium₃Pd, calcium₅Pd₂, Sn₃Sr, Ba₁₃Ti, PdT₂ and FeSe₂, FeSe, Cr₂Te₃, CrTe₃, and FeSn₂.

[0391] [Example 11] It sets on the super resolution read-out film, and is Cr₄Te₅ in the combination of the above-mentioned high-melting component and the above-mentioned phase change component. GeSb₂Te₄ The same element as each component existed, it constructed, and the super resolution read-out property had [like] good *****. However, since the difference of the melting point of both components stopped coming out when there are too many amounts of the same element, below 80 atom % in a component of the amount of the same element was desirable. Moreover, when there were few amounts, the refractive index of both the components in an aperture part did not become equal in many cases, and more than 30 atom % was desirable.

[0392] [Example 12] GeSb₂Te₄ was used as a phase change component in the super resolution read-out film, Cr₄Te₅ was used as a high-melting component, and the following results were obtained, when the high-melting quantitative formula (atomic %) was changed and C/N and the count which can be super resolution read were investigated.

[0393]

High-melting quantitative formula (atomic %) Count which can be super resolution read (time)

----- 5 6x105 10 1x106 20 2x106>=30 >=2x106 High-melting quantitative formula (%) C/N (dB)

----- <=30 >=48 40 48 50 46 60 42 -- it turns out that a high-melting quantitative formula has 10 -- 50% of desirable range, and 20 -- 40% of range is more more desirable than this result.

[0394] It is desirable to use the content of an oxide, a sulfide, a nitride, and carbide as less than 50% of a high-melting component in a high-melting component, and it is desirable especially to consider as less than 20%. If there are many these contents, the difference of complex index of refraction with a phase change component cannot be made small, or it is easy to produce the problem which oxygen etc. is spread [problem] and degrades a super resolution read-out property in a phase change component.

[0395] [Example 13] It was as follows, when the presentation of a phase change component was changed and optimal super resolution read-out power was investigated with the super resolution read-out film ingredient, since the melting points of the super resolution read-out film differed. Cr₄Te₅ was used as a high-melting component.

[0396]

Presentation of the phase change component in the film The membranous melting point (degree C) Super

resolution read-out power (mW)

Sn75Zn25 250 3 In2Te5 450 6 germanium2Sb2Te5 650 The power at the time of super resolution read-out is low, and ends, and the one where the melting point of 8 super-resolution read-out film is lower is desirable.

[0397] [Example 14] In engine-speed regularity, the inner circumference of a disk differs in linear velocity from a periphery. By the 5 inch disk, when super resolution read-out thickness was changed so that it might be set to 20nm in inner circumference and might be set to 40nm on a periphery corresponding to this since linear velocity changed to 5.7 – 11.3 m/s, inner circumference became small and the width of face of the field by which a mask is not carried out among optical spots acquired the good super resolution read-out property of C/N48dB in both inner circumference and a periphery. Moreover, it goes to a periphery from inner circumference, and is GeSb2Te4 of a GeSbTe system. Or germanium2Sb2Te5 Since a crystallization rate became early so that it goes to a periphery when the amount of gaps from a presentation is lessened, linear velocity correspondence became easy and acquired the good super resolution read-out property of C/N48dB in both inner circumference and a periphery.

[0398] [Example 15] The block diagram of the super resolution read-out system of the equipment for super resolution read-out is shown in drawing 14. In response to the super resolution read-out command 42, laser radiation is performed from the optical head 50, and the reflected light which has returned from the optical disk 51 is again detected with the optical head 50.

[0399] When using continuation light as a laser beam, it considers as the network of (a) of drawing, and in using pulsed light, the pulse-sized circuit 43 is incorporated and it considers as the network of (b). The synchronization of pulsed light is performed through address part and the flag section detection 45.

[0400] In order to acquire a good super resolution read-out property, the laser power setting circuit 47 maintains the relation between tracking and the laser power Pt for automatic-focusing doubling, and the laser power Pr for super resolution read-out like a degree type.

[0401] In order to make it a high-melting component stop at solid phase, it carried out detection analysis of the turbulence of the reflected light intensity distribution of return light in the optical intensity-distribution analysis circuit 48 at the time of a laser power exposure, and included the circuit which can adjust laser power according to scale of turbulence in the laser power setting circuit 47, without the whole film's dissolving also in $Pr/Pt >= 2$ and the field used as the maximum temperature of the film for super resolution read-out. Thereby, degradation of the film for super resolution read-out stopped being able to happen easily.

[0402] Here, the turbulence of optical intensity distribution is time fluctuation of a ratio, time fluctuation of turbulence, i.e., each detector output, of optical intensity distribution. The output of each detector was connected and detected in the optical intensity-distribution analysis circuit 48 using that by which two or more detectors arranged one-dimension-wise [the turbulence of optical intensity distribution] or two-dimensional have been arranged almost in parallel with a record-medium side.

[0403] In order to prevent degradation of the film for super resolution read-out, the super resolution read-out laser beam was made into pulsed light. Since a spot lapped 30% or more in the range of $0.4 \lambda/NA \leq vT$ by the disk which the ratio (a:lambda/NA) of die-length a of the core of the direction of a truck of the diameter of a laser spot (lambda/NA) and an aperture is made to 1 / 3 – 1/2 at this time, and has a minute mark, there was little effectiveness of pulse-izing, and it turned out that a mark is skipped in the range of $vT \leq 1.5 \lambda/NA$.

[0404] Then, in order to ensure super resolution read-out of a mark, the circuit for filling a bottom type was included in the pulse-sized circuit 43 of drawing 14.

[0405] $0.4\lambda/NA \leq vT \leq 1.5\lambda/NA$ $0.3k \leq x/T \leq 0.5k$, consequently C/N46dB were able to be obtained. k was a proportionality constant and was k= 1 in the disk of the structure of drawing 7 at the time of laser power 8mW and linear velocity 8 m/s. Furthermore, when the bottom type was filled, C/N improved by 2dB.

[0406] $0.5\lambda/NA \leq vT \leq 0.9\lambda/NA$ $0.3k \leq x/T \leq 0.5k$ [example 16] drawing 9 shows an example of the structure section Fig. of the disk which can be written which used the super resolution read-out film of this invention. In this example, the super resolution read-out film which has the average presentation of said general formula (8) was used.

[0407] First, the polycarbonate substrate with a diameter [of 13cm] and a thickness of 1.2mm was formed. Next, it had two or more targets for this substrate, and the cascade screen could be formed one by one, and it attached in the magnetron sputtering system with the sufficient homogeneity of thickness and repeatability, and 80 (ZnS) (SiO2) 20 layer with a thickness of 125nm was formed on this. Then, 30nm, 80 (ZnS) (SiO2) 20 layer, and 30nm of 20 (Cr4Te5) (GeSb2Te4) 80 film were formed for 80 (Sn3Zn) (SnTi2) 20 film. Next (ZnS), the laminating of 20nm and the 100nm of the aluminum-Ti layers was carried out for 80 (SiO2) 20 layer one by one. Then, the polycarbonate substrate was stuck and set through the glue line on this. Although this disk

can use only one side, it is good also as double-sided structure where produced two things of the same structure and it was made to rival by the glue line.

[0408] In the part which performs super resolution read-out, laser power was set to 3mW and super resolution read-out was performed. This power changes with melting points of the super resolution read-out film. When passing the super resolution read-out part, laser power was lowered to 1mW and tracking and automatic-focusing doubling were continued. In addition, tracking and automatic-focusing doubling are continued also during super resolution read-out.

[0409] After super resolution read-out, since the super resolution read-out film crystallized again, crystallization was unnecessary.

[0410] [Example 17] The content of Sn and Ti is changed in the super resolution read-out film which consists of 80 (Sn₃Zn) (SnTi₂) 20 shown in drawing 9 of said example 16, keeping the content of Zn constant, and it is slack, and the count which can be super resolution read and 105. C/N of the regenerative signal after time super resolution read-out changed as follows.

[0411]

Group ** The count which can be super resolution read ----- Sn55Zn20Ti25 > 2x106 Time Sn67Zn20Ti13 2x106 Time Sn75Zn20Ti5 1x106 Time Sn80Zn20 5x105 Time Group ** 105 C/N of the regenerative signal after time super resolution read-out ----- Sn25Zn20Ti55 44dB Sn30Zn20Ti50 46dB Sn40Zn20Ti40 48dB Sn55Zn20Ti25 50dB can come and the range of e in said general formula (8) and f is understood more that 30<=e<=95 and 5<=f<=50 are desirable, and 40<=e<=87 and 13<=f<=40 are more desirable.

[0412] Furthermore, it is 105, when adding Ti and changing the content as follows in the super resolution read-out film 26 which consists of above 80 (Sn₃Zn) (SnTi₂) 20, keeping the content of Sn, Zn, and Ti constant. C/N of the regenerative signal after time super resolution read-out changed as follows.

[0413]

Ti content 105 C/N of the regenerative signal after time super resolution read-out ----- g=0 % 46dB g=10 % 48dB g=20 % 46dB g=25 % It turns out that 0<=g<=20 is desirable as for the range of g in said general formula (8), and 0<=g<=10 is more more desirable than this 43dB.

[0414] moreover, the combination of said D, D' (in the case [Said D is D and D' like Above Sn and Zn.] of two elements), and E and F -- setting -- D-E, E-F, and D' -- or the high-melting component made from the combination of -E does not have the eutectic point -- the eutectic point --- **** --- even if it was, the thing with 150-degree-C or more melting point higher than the melting point of D and D-D' was desirable.

[0415] [Example 18] the super resolution read-out film which consists of Sn-Zn-Ti of said example 16 The ingredient of the average presentation expressed with said general formula (8), Pb-Se, Pb-Ce, Pb-La, Pb-Pt, Pb-Si, Sn-Sb, Sn-Se, Sn-Co, Sn-Cu, Sn-nickel, Sn-Pt, Bi-Te, Bi-Se, Bi-Ce, Bi-Cu, Bi-Cd, Bi-Pt, Zn-nickel, Zn-Pt, Zn-La, Zn-Ce, Ga-Cr, Ga-Cu, Ga-nickel, Ga-La, Ga-Pt, Ga-Ce, In-Se, In-Sb, In-Te, In-As, In-Mn, In-nickel, In-Ag, Pb-Sn-Se, Pb-Sn-Ce, Pb-Sn-La, Pb-Sn-Pt, Pb-Sn-Si, Pb-Sn-Sb, Pb-Sn-Co, Pb-Sn-Cu, Pb-Sn-nickel, Sn-Bi-Sb, Sn-Bi-Se, Sn-Bi-Co, Sn-Bi-Cu, Sn-Bi-nickel, Sn-Bi-Pt, Sn-Bi-Te, Sn-Bi-Ce, Sn-Bi-Cd, Zn-Sn-Sb, Zn-Sn-Se, Zn-Sn-Co, Zn-Sn-Cu, Zn-Sn-nickel, Zn-Sn-Pt, Zn-Sn-nickel, Zn-Sn-La, Zn-Sn-Ce, Sn-Ga-Sb, Sn-Ga-Se, Sn-Ga-Co, Sb-Ga-Cu, Sn-Ga-nickel, Sn-Ga-Pt, Sn-Ga-Cr, Sn-Ga-La, Sn-Ga-Ce, Bi-Ga-Te, Bi-Ga-Se, Bi-Ga-Cu, Bi-Ga-Cd, Bi-Ga-Pt, Bi-Ga-Cr, Bi-Ga-nickel, Bi-Ga-La, Bi-Ga-Ce, In-Ga-Cr, In-Ga-Cu, In-Ga-nickel, In-Ga-La, In-Ga-Pt, In-Ga-Ce, In-Ga-Se, In-Ga-Sb, In-Ga-Te, In-Ga-As, In-Ga-Mn, Even if it changes into In-Ga-Ag, In-Bi-Te, In-Bi-Se, In-Bi-Cu, In-Bi-Cd, In-Bi-Pt, In-Bi-Sb, In-Bi-As, In-Bi-Mn, In-Bi-nickel, In-Bi-Ag, In-Bi-Ce, etc. The same result was obtained.

[0416] [Example 19] The same result is obtained even if it changes the super resolution read-out film which consists of 80 (Sn₃Zn) (SnTi₂) 20 of said example 16 into the ingredient 9 of the average presentation expressed with said general formula (11), for example, Se51In40Cr etc., (high-melting component Cr₃Se₄; phase change component;InSe). however, the count which can be read -- 2x106 more than a time -- 105 p in said general formula (11) from which C/N of the regenerative signal after time super resolution read-out is set to 46dB or more, and q. -- the range of r and s -- 40<=p<=95 and 0<=q<= -- it was 55, 5<=r<=50, and 0<=s<=20. Desirable range was 50<=p<=80, 0<=q<=40, 10<=r<=40, and 0<=s<=10 rather than C/N was set to 48dB or more. Moreover, this presentation has been used also as phase change record film 28. It can be used also as phase change record film of the record medium which does not use the super resolution read-out film.

[0417] [Example 20] the super resolution read-out film which consists of Se-In-Cr of said example 19 The ingredient of the average presentation expressed with said general formula (2), Se-In-Si, Se-In-Ag, Se-In-aluminum, Se-In-Ba, Se-In-calcium, Se-In-Cd, Se-In-Co, Se-In-Cu, Se-In-Mg, Se-In-Mn, Se-In-Mo, Se-In-nickel, Se-In-Pd, Se-In-Pt, Se-In-Ta, Se-In-Ti, Se-In-V, Se-In-W, Se-In-Y, Se-In-Pb, Se-Sb-Si, Se-Sb-Ag,

Se-Sb-aluminum, Se-Sb-Ba, Se-Sb-calcium, Se-Sb-Cd, Se-Sb-Co, Se-Sb-Cr, Se-Sb-Cu, Se-Sb-Mg, Se-Sb-Mn, Se-Sb-Mo, Se-Sb-nickel, Se-Sb-Pd, Se-Sb-Pt, Se-Sb-Ta, Se-Sb-Ti, Se-Sb-V, Se-Sb-W, Se-Sb-Y, Se-Sb-Pb, Se-Bi-Si, Se-Bi-Ag, Se-Bi-aluminum, Se-Bi-Ba, Se-Bi-calcium, Se-Bi-Cd, Se-Bi-Co, Se-Bi-Cr, Se-Bi-Cu, Se-Bi-Mg, Se-Bi-Mn, Se-Bi-Mo, Se-Bi-nickel, Se-Bi-Pd, Se-Bi-Pt, Se-Bi-Ta, Se-Bi-Ti, Se-Bi-V, Se-Bi-W, Se-Bi-Y, Se-Bi-Pb, Se-Te-Si, Se-Te-Ag, Se-Te-aluminum, Se-Te-Ba, Se-Te-calcium, Se-Te-Cd, Se-Te-Co, Se-Te-Cr, Se-Te-Cu, Se-Te-Mg, Se-Te-Mn, Se-Te-Mo, Se-Te-nickel, Se-Te-Pd, Se-Te-Pt, Se-Te-Ta, Se-Te-Ti, Se-Te-V, Se-Te-W, Se-Te-Y, Se-Te-Pb, Se-Au-Si, Se-Au-Ag, Se-Au-aluminum, Se-Au-Ba, Se-Au-calcium, Se-Au-Cd, Se-Au-Co, Se-Au-Cr, Se-Au-Cu, Se-Au-Mg, Se-Au-Mn, Se-Au-Mo, Se-Au-nickel, Se-Au-Pd, Se-Au-Pt, Se-Au-Ta, Se-Au-Ti, Se-Au-V, Se-Au-W, Se-Au-Y, Se-Au-Pb, Se-B-Si, Se-B-Ag, Se-B-aluminum, Se-B-Ba, Se-B-calcium, Se-B-Cd, Se-B-Co, Se-B-Cr, Se-B-Cu, Se-B-Mg, Se-B-Mn, Se-B-Mo, Se-B-nickel, Se-B-Pd, Se-B-Pt, Se-B-Ta, Se-B-Ti, Se-B-V, Se-B-W, Se-B-Y, Se-B-Pb, Se-Cs-Si, Se-Cs-Ag, Se-Cs-aluminum, Se-Cs-Ba, Se-Cs-calcium, Se-Cs-Cd, Se-Cs-Co, Se-Cs-Cr, Se-Cs-Cu, Se-Cs-Mg, Se-Cs-Mn, Se-Cs-Mo, Se-Cs-nickel, Se-Cs-Pd, Se-Cs-Pt, Se-Cs-Ta, Se-Cs-Ti, Se-Cs-V, Se-Cs-W, Se-Cs-Y, Se-Cs-Pb, Se-Sn-Si, Se-Sn-Ag, Se-Sn-aluminum, Se-Sn-Ba, Se-Sn-calcium, Se-Sn-Cd, Se-Sn-Co, Se-Sn-Cr, Se-Sn-Cu, Se-Sn-Mg, Se-Sn-Mn, Se-Sn-Mo, Se-Sn-nickel, Se-Sn-Pd, Se-Sn-Pt, Se-Sn-Ta, Se-Sn-Ti, Se-Sn-V, Se-Sn-W, Se-Sn-Y, Se-Sn-Pb, Se-Tl-Si, Se-Tl-Ag, Se-Tl-aluminum, Se-Tl-Ba, Se-Tl-calcium, Se-Tl-Cd, Se-Tl-Co, Se-Tl-Cr, Se-Tl-Cu, Se-Tl-Mg, Se-Tl-Mn, Se-Tl-Mo, Se-Tl-nickel, Se-Tl-Pd, Se-Tl-Pt, Se-Tl-Ta, Se-Tl-Ti, Se-Tl-V, Se-Tl-W, Se-Tl-Y, Se-Tl-Pb, Se-S-Si, Se-S-Ag, Se-S-aluminum, Se-S-Ba, Se-S-calcium, Se-S-Cd, Se-S-Co, Se-S-Cr, Se-S-Cu, Se-S-Mg, Se-S-Mn, Se-S-Mo, Se-S-nickel, Se-S-Pd, Se-S-Pt, Se-S-Ta, Se-S-Ti, Se-S-V, Se-S-W, Se-S-Y, Se-S-Pb, Se-germanium-Si, Se-germanium-Ag, Se-germanium-aluminum, Se-germanium-Ba, Se-germanium-calcium, Se-germanium-Cd, Se-germanium-Co, Se-germanium-Cr, Se-germanium-Cu, Se-germanium-Mg, Se-germanium-Mn, Se-germanium-Mo, Se-germanium-nickel, Se-germanium-Pd, Se-germanium-Pt, Se-germanium-Ta, Se-germanium-Ti, Se-germanium-V, Se-germanium-W, Se-germanium-Y, Se-germanium-Pb, Se-Fe-Si, Se-Fe-Ag, Se-Fe-aluminum, Se-Fe-Ba, Se-Fe-calcium, Se-Fe-Cd, Se-Fe-Co, Se-Fe-Cr, Se-Fe-Cu, Se-Fe-Mg, Se-Fe-Mn, Se-Fe-Mo, Se-Fe-nickel, Se-Fe-Pd, Se-Fe-Pt, Se-Fe-Ta, Se-Fe-Ti, Se-Fe-V, Se-Fe-W, Se-Fe-Y, Se-Fe-Pb, Se-Zn-Si, Se-Zn-Ag, Se-Zn-aluminum, Se-Zn-Ba, Se-Zn-calcium, Se-Zn-Cd, Se-Zn-Co, Se-Zn-Cr, Se-Zn-Cu, Se-Zn-Mg, Se-Zn-Mn, Se-Zn-Mo, Se-Zn-nickel, Se-Zn-Pd, Se-Zn-Pt, The same result was obtained even if changed into Se-Zn-Ta, Se-Zn-Ti, Se-Zn-V, Se-Zn-W, Se-Zn-Y, Se-Zn-Pb, etc.

[0418] [Example 21] Drawing 7 shows the cross section of the disk-like information record medium only for playbacks with which information was minced in the concavo-convex bit on the surface of the substrate.

[0419] It is only differing from the disk-like medium of an example 1, and other configurations have that, as for this disk-like medium, the bit is formed on the surface of a substrate, and the the same point using record film as the mask layer 13 and 13'.

[0420] Namely, on the polycarbonate substrate 11 and 11' which have an information bit on a front face The protective layer 12 and 12' which consist of 80 (ZnS) (SiO₂) 20 film of about 125nm of thickness are formed, respectively. On a protective layer 12 and 12', in order The island-shape Ag₂Te film of 3nm of average thickness (not shown), About 30nm of thickness (with 30 (Ag₂Te) (Se₈₀-Te₂₀) 70 [13], i.e., the mask layer of a presentation of Ag₂₀Te₂₄Se₅₆, and 13') thickness -- about -- 25 -- nm -- 80 (ZnS) (SiO₂) -- 20 -- the film -- becoming -- an interlayer -- 14 -- 14 -- ' -- thickness -- 80 -- nm -- aluminum -- 97 -- Ti -- three -- the film -- becoming -- a reflecting layer -- 15 -- 15 -- ' -- respectively -- forming -- having -- ****. A reflecting layer 15 and 15' are stuck by a vinyl chloride and the vinyl acetate system hot-melt-adhesive layer 16. Incidence of the laser beam for read-out is carried out from a substrate side. In the mask layer 13 and 13', high-melting component Ag₂Te deposits with the same gestalt (refer to drawing 1) as an example 1, and the residual element (thing equivalent to phase change component 3a in drawing 1) is (Se₈₀-Te₂₀).

[0421] (Other examples of a high-melting component) As the mask layer 13 and a high-melting component which deposited in 13', what was stated in the examples 1 and 3 in addition to Ag₂Te can be used. Formation of the island-shape Ag₂Te film may be omitted.

[0422] A part or all of Se₈₀-Te₂₀ that is residual elements other than a high-melting component Sn, Pb, Sb, Bi, Te, Zn, Cd, Se, In, Ga, S, Ti, Mg, Ti₂Se, TiSe, Ti₂Se₃, Ti₃Te₂, TiTe, (Other examples of the residual element after a high-melting component deposit) InBi, In₂Bi, TeBi, Ti-Se, Ti-Te, Pb-Sn, Bi-Sn, Se-Te, S-Se, Bi-Ga, Sn-Zn, Ga-Sn, Ga-In, and In₃ -- SeTe₂, AgInTe₂, GeSb₄Te₇, germanium₂Sb₂Te₅, and GeSb₂Te₄ -- GeB₄Te₇, GeBi₂Te₄, germanium₃Bi₂Te₆, Sn₂Sb₆Se₁₁, Sn₂Sb₂Se₅, SnSb₂Te₄, and Pb₂Sb₆ -- Te₁₁, CuAsSe₂, Cu₃AsSe₃, CuSbS₂ and CuSbSe₂, InSe, Sb₂Se₃, and Sb₂Te₃ -- Bi₂Te₃, SnSb, FeTe, and Fe₂ -- Te₃, FeTe₂, ZnSb, Zn₃Sb₂, and VTe₂ and V₅ -- the ingredient which uses at least 1 person of Te₈, AgIn₂,

BiSe, InSb, In₂Te, and In₂Te₅ as a principal component -- Or a near property is acquired even if it replaces with the ingredient of the presentation near it.

[0423] This residual element has desirable metal, compound, or alloy whose melting point is below 650-degreeC.

[0424] Moreover, in a super resolution readout, if the thickness of each class is changed, contrary to drawing 14, the mask only of the fields other than the slash section in an optical spot can also be carried out.

[0425] When the melting point of a residual element is below 250-degreeC, if the melting point of a high-melting component is more than 450-degreeC, the property near this will be acquired.

[0426] light -- a spot -- 31 -- a diameter -- about -- 25 -- % -- die length -- record -- a mark -- forming -- having -- **** -- a case -- a laser beam -- an exposure -- order -- it can set -- a mask -- a layer -- 13 -- 13 -- ' -- an extinction coefficient -- k -- variation -- ** -- k -- ' -- changing -- if -- 105 -- a time -- having read -- the back -- a regenerative signal -- C/N -- as follows -- having changed .

[0427]

C/N **k'= of the regenerative signal after 105 times read-out 5% 37dB **k'=10% 42dB **k'=20% 46dB
k'=30% 48dB was understood that the range of 20%<=k' is more desirable than this result.

[0428] When the melting point (m. p.) of the residual element after a deposit of a high-melting component changed, C/N of the regenerative signal after reading 105 times changed as follows.

[0429]

C/N m.p.=100 degreeC of the regenerative signal after 105 times read-out 49dBm.p.=250-degreeC
48dBm.p.=400-degreeC 47dBm.p.=650-degreeC 46dBm.p.=700-degreeC 40dBm.p.=750-degreeC It turned out that below 650-degreeC of the melting point of the residual element after a high-melting component deposit is desirable, and below 250-degreeC is more more desirable than this result 33dB.

[0430] [Example 22] Drawing 9 is an example of an information record medium which enabled it to use the "super resolution effectiveness" at the time of informational playback by preparing the mask layer same to the information record medium of the phase change mold of an example 1 as an example 4.

[0431] This disk-like medium has the same configuration as the information record medium of an example 1, except that the configurations of record film differ. namely, -- an example -- one -- being the same -- a polycarbonate -- a substrate -- one -- one -- ' -- a top -- 80 (ZnS) (SiO₂) -- 20 -- the film -- becoming -- a protective layer -- two -- two -- ' -- respectively -- forming -- having -- a protective layer -- two -- two -- ' -- a top -- **** -- order -- record film -- three -- three -- ' -- 80 (ZnS) (SiO₂) -- 20 -- the film -- becoming -- an interlayer -- four -- four -- ' -- aluminum -- 97 -- Ti -- three -- the film -- becoming -- a reflecting layer -- five -- five -- ' -- respectively -- forming -- having -- **** . A reflecting layer 5 and 5' are stuck by the adhesives layer 6.

[0432] record film 3' -- substrate 1' -- it consists of the mask layers, dielectric layers, and recording layers which have been arranged sequentially from a side. Record film 3 is also the same configuration as record film 3'.

[0433] A mask layer is the same as an example 21 (it has the presentation of 30 (Se80-Te20) 7056, i.e., Ag20Te24Se, and has the same mask function as an example 21.). (Ag₂Te) The dielectric layer is formed with 80 (ZnS) (SiO₂) 20 film. As a recording layer, the recording layer of the phase change mold of arbitration besides the same thing as the record film 3 of an example 1 and 3' can be used.

[0434] When a record mark with a die length of 0.4 micrometers was formed in a cycle of 0.8 micrometer, C/N of the acquired regenerative signal was 46dB or more, and the elimination ratio was 25dB or more.

[0435] This mask layer has the same effectiveness also in the information record medium according record to record principles other than a **** information record medium and phase changes, such as a magneto-optic disk, by the conventional phase changes other than the thin film for information record of this invention.

[0436] About the point which has not been stated in this example, it is the same as that of an example 1.

[0437] [Example 23] The disk-like information record medium of this example is the configuration almost same although not illustrated as having been shown in drawing 3 of an example 1, is replaced with the aluminum-Ti reflecting layer 1 of an example 1, and 1', and it differs in that the layer containing record film 3 and a high-melting component like 3' is used as a reflecting layer.

[0438] About the high-melting component in a reflecting layer, it is the same as that of an example 1.

[0439] About the residual element after the high-melting component in a reflecting layer deposits, the metal, compound, or alloy whose melting point is below 650-degreeC is desirable, and it is desirable that the real part n or imaginary part (extinction coefficient) k of complex index of refraction changes with the exposures of a laser beam 20% or more, and a reflection factor R becomes [real part n and imaginary part k] 60% or more when high.

[0440] As a reflecting layer, when 70 layer of 30(LaBi) Bi(s) of 80nm of thickness are used, the super

resolution effectiveness at the time of read-out is acquired, and it is die length of 0.4 micrometers. When a record mark was written in a cycle of 0.8 micrometer, C/N of the acquired regenerative signal was 46dB or more, and the elimination ratio was 25dB or more. In addition, in 70 layer of 30(LaBi) Bi(s), a high-melting component is LaBi and a phase change component is Bi.

[0441] The principle from which the super resolution effectiveness is acquired is as follows. As shown in drawing 8 , in order [in a reflecting layer] for the phase change component Bi to dissolve at least and for either [at least] the real part n of complex index of refraction or the imaginary part k to fall, in the elevated-temperature field 35 in the optical spot 31, the reflected light in the range 33 committed as a mask of drawing 8 becomes weak. It becomes impossible for this reason, for the reflected light from the range 33 to offer sufficient contrast for reading to record film.

[0442] On the other hand, in the low-temperature field of the crystallized solid state, since either [at least] the real part n of complex index of refraction or the imaginary part k is large compared with an elevated-temperature field, sufficient contrast for reading can be offered.

[0443] Consequently, the detection range 34 becomes crescent shape like drawing 8 , and becomes possible [reading certainly the record mark 32 by which high density record was carried out with the period below the diameter of the optical spot 31].

[0444] If the thickness of each class is changed, the magnitude of the detection range 34 is also changeable.

[0445] A part or all of Bi that is the residual elements of the high-melting component LaBi Sn, Pb, Sb, Te, Zn, Cd, Se, In, Ga, S, Ti, Mg, Ti2Se, TiSe, Ti2Se3, Ti3Te2, TiTe, InBi, In2Bi, TeBi, (Other examples of a residual element) Ti-Se, Ti-Te, Pb-Sn, Bi-Sn, Se-Te, S-Se, Bi-Ga, Sn-Zn, Ga-Sn, Ga-In, and In3 -- SeTe2, AgInTe2, GeSb4Te7, germanium2Sb2Te5, GeSb2Te4, and GeBi4Te7 -- GeBi2Te4, germanium3Bi2Te6, Sn2Sb6Se11, Sn2Sb2Se5, SnSb2Te4, and Pb2Sb6 -- Te11, CuAsSe2, Cu3AsSe3, CuSbS2 and CuSbSe2, InSe, Sb2Se3, Sb2Te3, and Bi2Te3 -- SnSb, FeTe, and Fe2 -- Te3, FeTe2, ZnSb, Zn3Sb2, and VTe2 and V5 -- a near property is acquired even if it replaces at least one of Te8, AgIn2, BiSe, InSb, In2Te, In2Te5, etc. with the ingredient used as a principal component.

[0446] When the melting point of a residual element is below 350-degreeC, if the melting point of a high-melting compound is more than 450-degreeC, a property near in the aforementioned case will be acquired.

[0447] (in addition to this) The reflecting layer of this example is applicable also to the optical recording medium which records by the conventional phase change which does not use the thin film for record of this invention, and the medium by other record principles, such as a magneto-optic-recording medium.

[0448] About the matter which has not been described here, it is the same as that of an example 1.

[0449]

[Effect of the Invention] As explained above, according to the thin film for information record and information record medium of this invention, it becomes rewritable [many times] from the former, holding good record and reproducing characteristics.

[0450] According to the manufacture approach of the thin film for information record this invention, the thin film for information record and information record medium of this invention are obtained easily.

[0451] As explained above, according to this invention, many super resolution read-out is possible, and a super resolution read-out property can obtain the good thin film for super resolution read-out, an information record medium, and super resolution read-out equipment.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] With the fragmentary sectional view of the thin film for record of the example of the information

record medium of this invention, as for (a), a porous high-melting component shows [as for that in which the granular high-melting component deposited, and (b)] what deposited, as for that in which the high-melting column-like component deposited, and (c).

[Drawing 2] With the fragmentary sectional view of the example of the information record medium of this invention, the sectional view where (a) met D-D line of (b), and (b) are the fragmentary sectional views of that information record medium.

[Drawing 3] It is the whole example sectional view of the information record medium of this invention.

[Drawing 4] With the fragmentary sectional view explaining the measuring method of the dimension of the high-melting component which deposited in the thin film for record, (a) shows a granular high-melting component and (b) and (c) show the high-melting column-like component.

[Drawing 5] It is the same fragmentary sectional view as drawing 2 (a) showing the example of the information record medium of this invention.

[Drawing 6] It is the triangular phase diagram of the example of the recording layer of the thin film for information record of this invention.

[Drawing 7] They are other whole example sectional views of the information record medium of this invention.

[Drawing 8] It is drawing for explaining the principle of the super resolution effectiveness.

[Drawing 9] It is the whole example sectional view of further others of the information record medium of this invention.

[Drawing 10] It is the triangular phase diagram of the example 4 of the recording layer of the thin film for information record of this invention.

[Drawing 11] It is the triangular phase diagram of the example 5 of the recording layer of the thin film for information record of this invention.

[Drawing 12] Drawing showing an example of the cross-section structure of the super resolution read-out disk by this invention.

[Drawing 13] Drawing showing the thickness of the super resolution read-out film, and the relation of a reflection factor.

[Drawing 14] The block diagram of super resolution read-out equipment.

[Description of Notations]

1 1' [-- Phase change component,] -- A substrate, 2, 2' -- A protective layer, 3, 3' -- Record film, 3a 3b [-- Adhesives layer,] -- A high-melting component, 4, 4' -- An interlayer, 5, 5' -- A reflecting layer, 6 a 11 and 11' -- substrate, and 12 and 12 -- protective layer, and '13, 13' -- interlayer, and -- record film, 14, and 14 '15, 15' -- a reflecting layer, 16 -- adhesives layers, 32a, a 32b -- record mark, and 33 -- the range committed as a mask, 34 -- detection range, and 35 -- elevated-temperature field.

[Translation done.]

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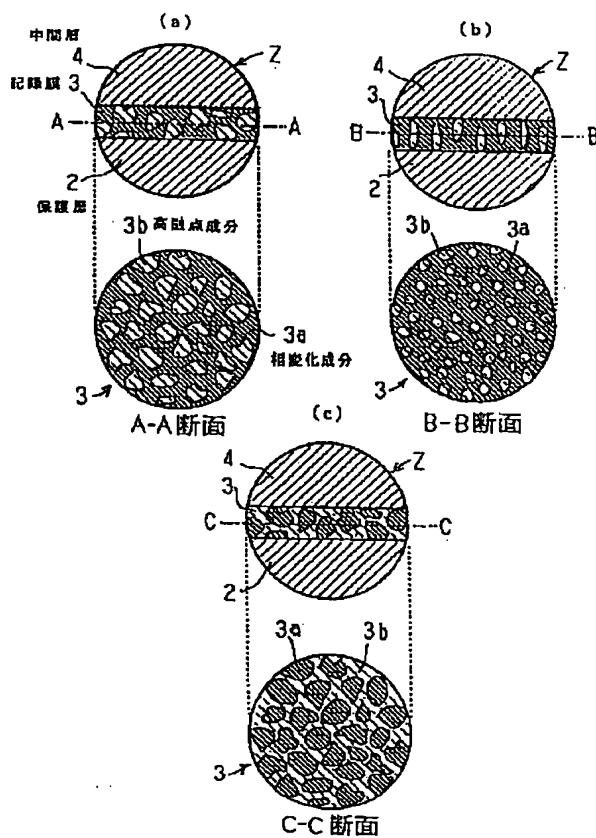
2.**** shows the word which can not be translated.

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DRAWINGS

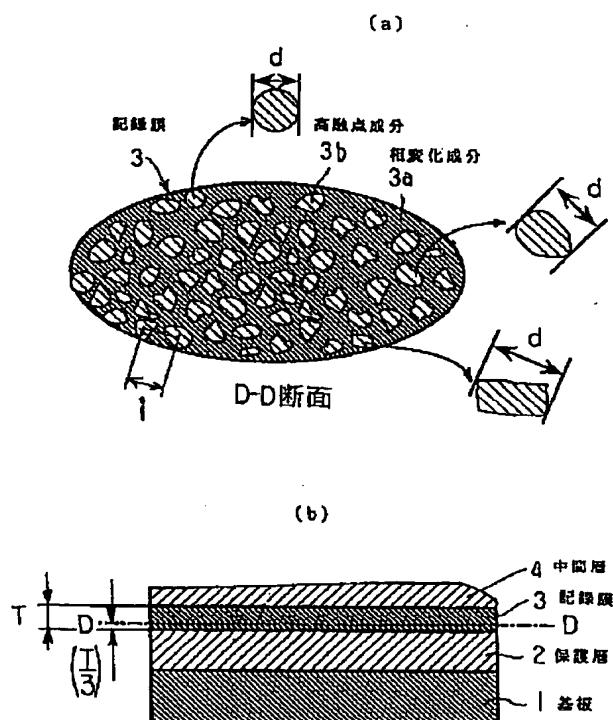
[Drawing 1]

図 1



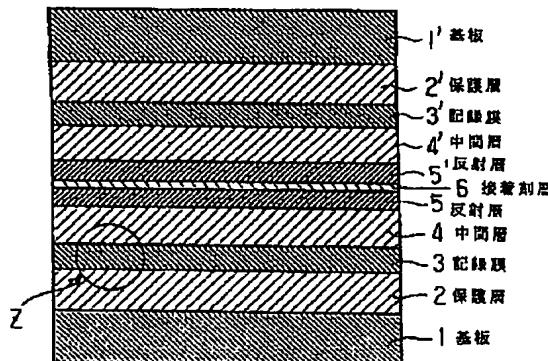
[Drawing 2]

図 2



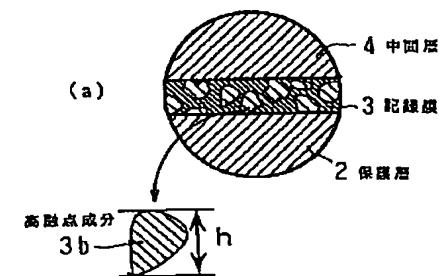
[Drawing 3]

図 3

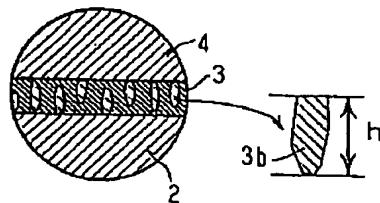


[Drawing 4]

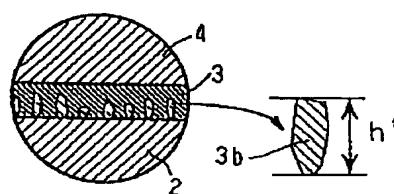
図 4



(b)

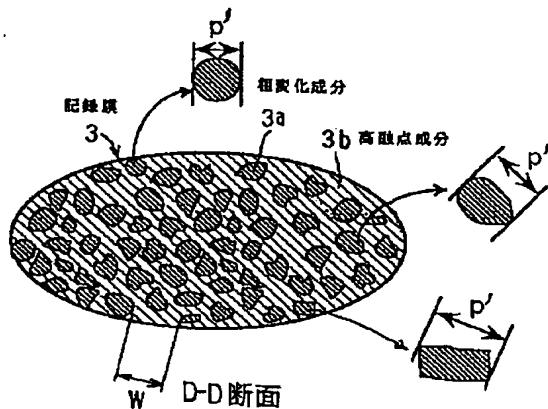


(c)



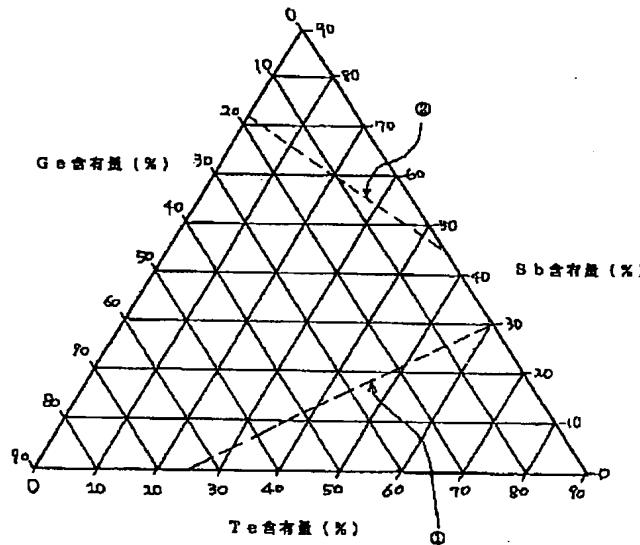
[Drawing 5]

図 5



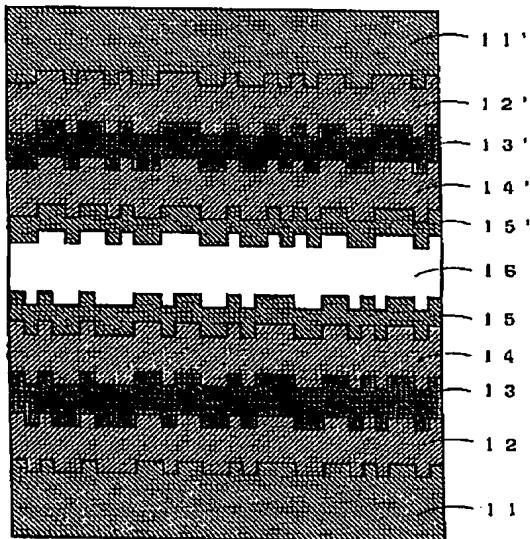
[Drawing 6]

図 6



[Drawing 7]

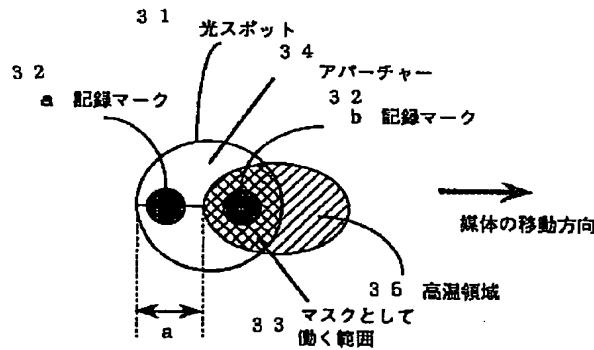
図 7



- 11, 11' : 基板
- 12, 12' : 保護層
- 13, 13' : マスク層
- 14, 14' : 中間層
- 15, 15' : 反射層
- 16 : 振動削層

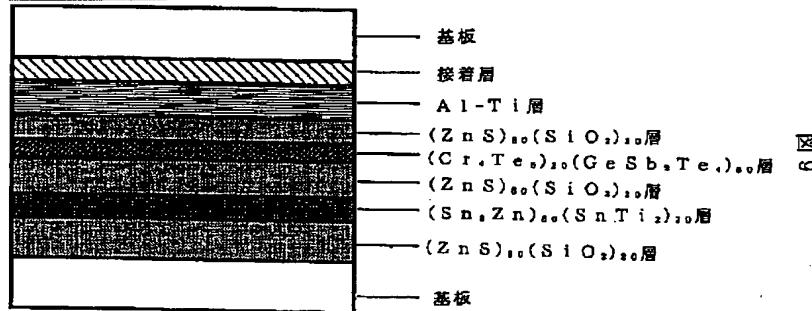
[Drawing 8]

図 8



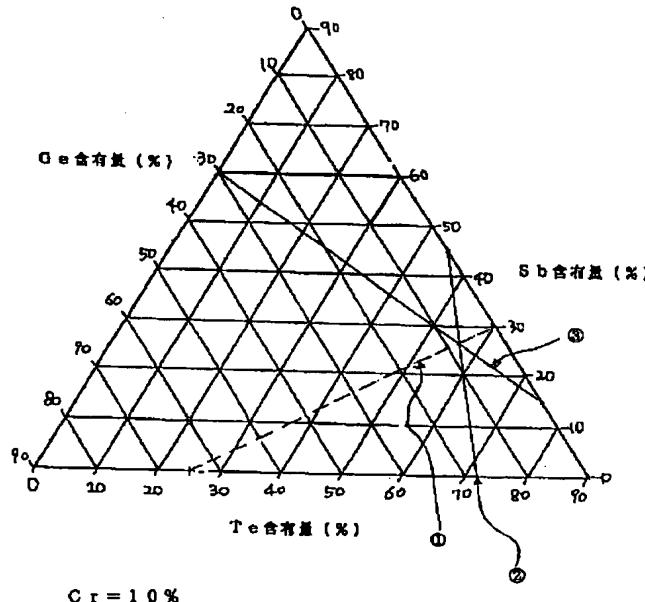
超解像読みだしの原理図

[Drawing 9]



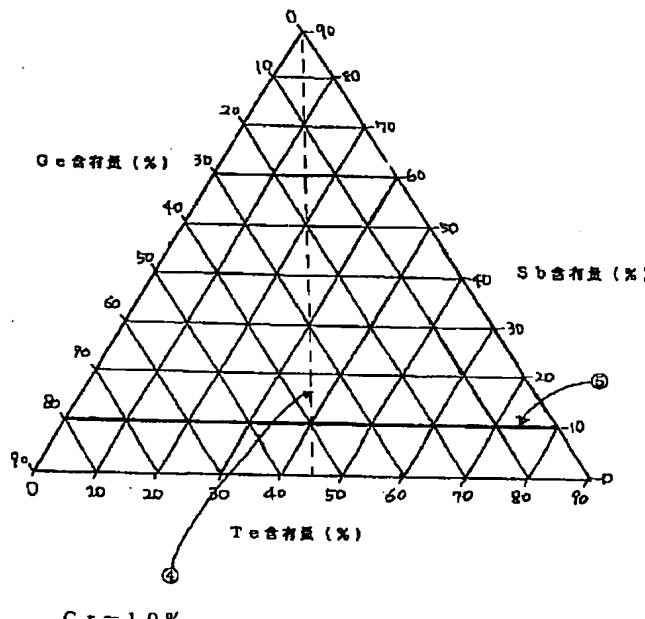
[Drawing 10]

図 10



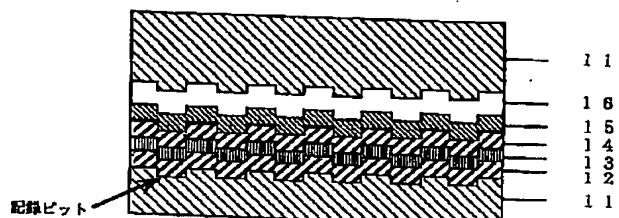
[Drawing 11]

図 1 1



[Drawing 12]

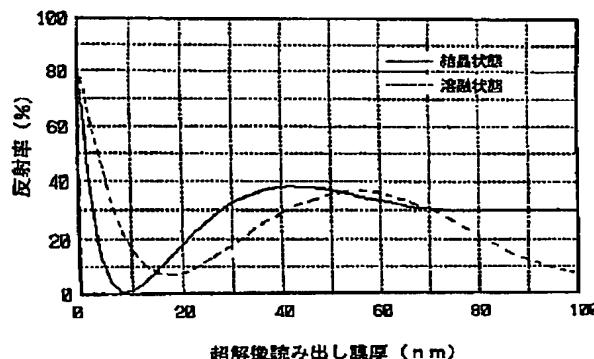
図 1 2



超解像読みだし用ディスクの断面構造

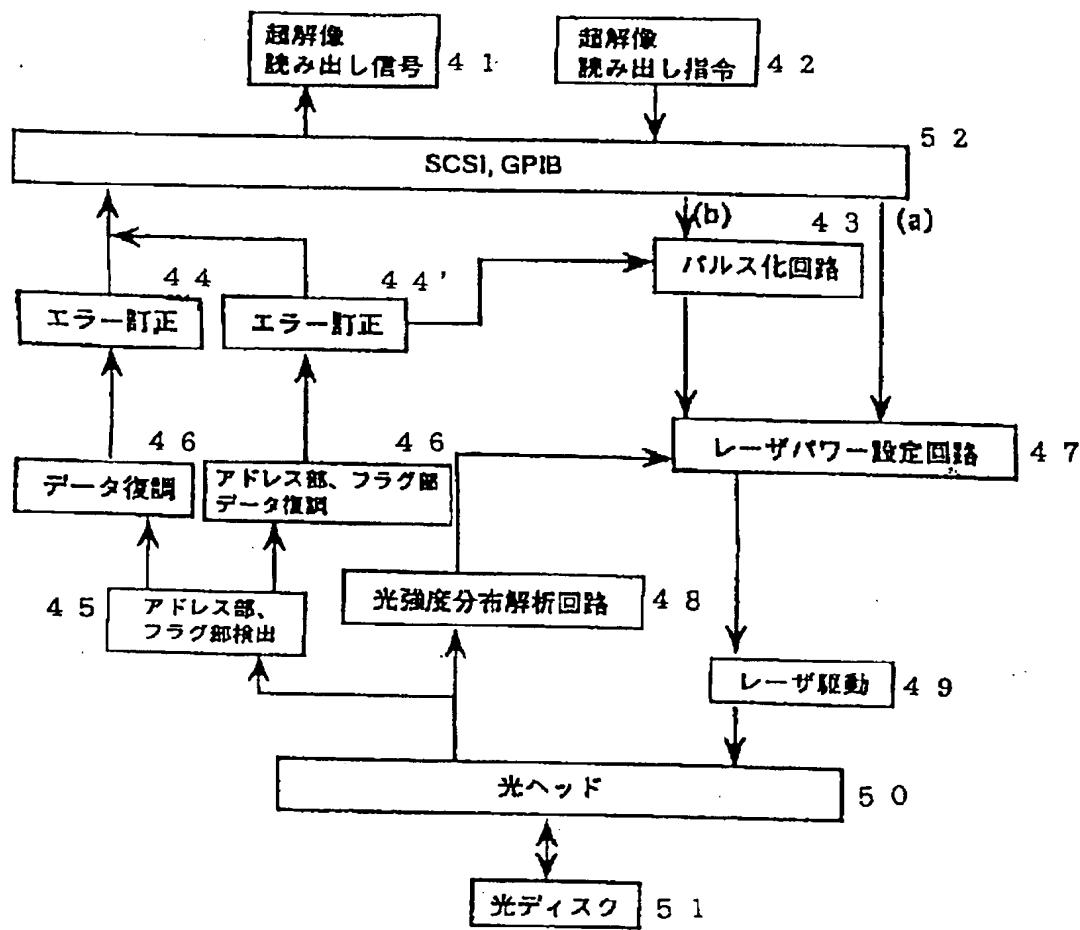
[Drawing 13]

図 1 3



[Drawing 14]

図 1-4



[Translation done.]

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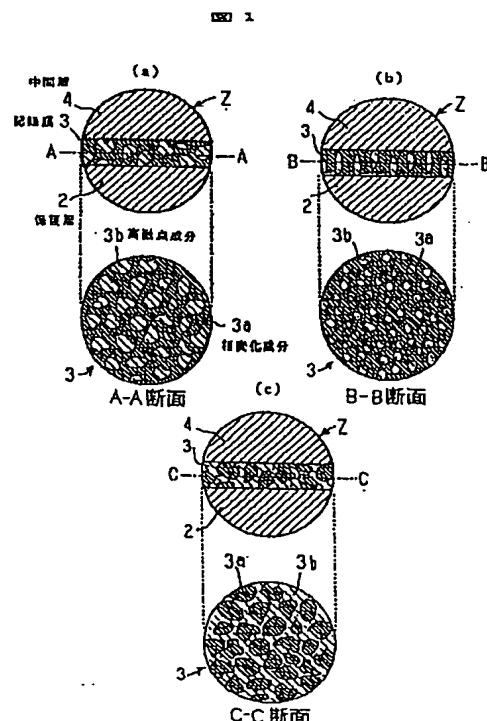
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(32) 優先日	平5(1993)11月29日		
(33) 優先権主張国	日本 (JP)		

(54) 【発明の名称】 情報記録用薄膜および情報記録媒体

(57) 【要約】

【目的】 良好的な記録・再生特性を保持しながら従来より多数回の書き換えまたは超解像読みだしを可能にする。

【構成】 Sb-Te-Ge系やSb-Te-In系の相変化型の記録膜3または超解像読み出し用薄膜に、Cr、およびAg、Ba、Co、Ni、Pt、Si、Sr、Au、Cd、Cu、Li、Mo、Mn、Zn、Al、Fe、Pb、Na、Cs、Ga、Pd、Bi、Sn、Ti、V、Inおよびランタノイド元素から選ばれた少なくとも一つの元素XまたはBを添加する。記録膜3中または超解像読み出し用薄膜中に相変化成分3aよりも高融点の成分3bが析出し、記録・消去、超解像読みだし時の膜の流動・偏析を防止する。



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【特許請求の範囲】

【請求項1】基板上に直接または保護層を介して形成された、エネルギーービームの照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用薄膜において、前記情報記録用薄膜の膜厚方向の平均組成が、一般式

$$S_{b_x} T_{e_y} A_p B_q C_r \quad (1)$$

で表わされ、

前記AはGeおよびInからなる第1群から選ばれた少なくとも一つの元素、前記Bはランタノイド元素およびAg, Ba, Co, Cr, Ni, Pt, Si, Sr, Au, Cd, Cu, Li, Mo, Mn, Zn, Al, Fe, Pb, Na, Cs, Ga, Pd, Bi, Sn, TiおよびVからなる第2群から選ばれた少なくとも一つの元素、前記CはSb, Teおよび前記AおよびBで表わされる元素以外の少なくとも一つの元素を表わし、前記x, y, p, qおよびrの単位はいずれも原子パーセントで、それぞれ $2 \leq x \leq 41$, $25 \leq y \leq 75$, $0.1 \leq p \leq 60$, $3 \leq q \leq 40$, $0.1 \leq r \leq 30$ の範囲にあることを特徴とする情報記録用薄膜。

【請求項2】基板上に直接または保護層を介して形成された、エネルギーービームの照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用薄膜において、

前記情報記録用薄膜の膜厚方向の平均組成が、一般式

$$S_{b_x} T_{e_y} A_p B_q \quad (2)$$

で表わされ、

前記AはGeおよびInからなる第1群から選ばれた少なくとも一つの元素、前記Bはランタノイド元素およびAg, Ba, Co, Cr, Ni, Pt, Si, Sr, Au, Cd, Cu, Li, Mo, Mn, Zn, Al, Fe, Pb, Na, Cs, Ga, Pd, Bi, Sn, TiおよびVからなる第2群から選ばれた少なくとも一つの元素を表わし、

前記x, y, pおよびqの単位はいずれも原子パーセントで、それぞれ $2 \leq x \leq 41$, $25 \leq y \leq 75$, $0.1 \leq p \leq 60$, $3 \leq q \leq 40$ の範囲にあることを特徴とする情報記録用薄膜。

【請求項3】基板上に直接または保護層を介して形成された、エネルギーービームの照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用薄膜において、

前記情報記録用薄膜の膜厚方向の平均組成が、一般式

$$S_{b_x} T_{e_y} B_q C_r \quad (3)$$

で表わされ、

前記Bはランタノイド元素およびAg, Ba, Co, Cr, Ni, Pt, Si, Sr, Au, Cd, Cu, Li, Mo, Mn, Zn, Al, Fe, Pb, Na, Cs, Ga, Pd, Bi, Sn, TiおよびVからなる群から選ばれた少なくとも一つの元素、前記CはSb, T

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eおよび前記Bで表わされる元素以外の少なくとも一つの元素を表わし、前記x, y, pおよびqの単位はいずれも原子パーセントで、それぞれ $2 \leq x \leq 41$, $25 \leq y \leq 75$, $3 \leq q \leq 40$, $0.1 \leq r \leq 30$ の範囲にあることを特徴とする情報記録用薄膜。

【請求項4】基板上に直接または保護層を介して形成された、エネルギーービームの照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用薄膜において、

前記情報記録用薄膜の膜厚方向の平均組成が、一般式

$$S_{b_x} T_{e_y} B_q \quad (4)$$

で表わされ、

前記Bはランタノイド元素およびAg, Ba, Co, Cr, Ni, Pt, Si, Sr, Au, Cd, Cu, Li, Mo, Mn, Zn, Al, Fe, Pb, Na, Cs, Ga, Pd, Bi, Sn, TiおよびVからなる群から選ばれた少なくとも一つの元素を表わし、

前記x, yおよびqの単位はいずれも原子パーセントで、それぞれ $2 \leq x \leq 41$, $25 \leq y \leq 75$, $3 \leq q \leq 40$ の範囲にあることを特徴とする情報記録用薄膜。

【請求項5】基板上に直接または保護層を介して形成された、エネルギーービームの照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用薄膜において、

前記情報記録用薄膜の膜厚方向の平均組成が、一般式

$$(Ge_a S_{b_b} T_{e_c})_{1-d} X_d \quad (5)$$

で表わされ、

前記XはCrおよびAg, Ba, Co, Ni, Pt, Si, Sr, Au, Cd, Cu, Li, Mo, Mn, Zn, Al, Fe, Pb, Na, Cs, Ga, Pd, Bi, Sn, Ti, V, In, W, Znおよびランタノイド元素の少なくとも一つの元素を表わし、それぞれ前記a, b, cおよびdが、それぞれ $0.02 \leq a \leq 0.19$, $0.04 \leq b \leq 0.4$, $0.5 \leq c \leq 0.75$, $0.03 \leq d \leq 0.3$ の範囲にあることを特徴とする情報記録用薄膜。

【請求項6】基板上に直接または保護層を介して形成された、エネルギーービームの照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用薄膜において、

前記情報記録用薄膜の膜厚方向の平均組成が、一般式

$$(Ge_a S_{b_b} T_{e_c})_{1-d} X_d \quad (5)$$

で表わされ、

前記XはCrおよびAg, Ba, Co, Ni, Pt, Si, Sr, Au, Cd, Cu, Li, Mo, Mn, Zn, Al, Fe, Pb, Na, Cs, Ga, Pd, Bi, Sn, Ti, V, In, W, Znおよびランタノイド元素の少なくとも一つの元素を表わし、前記a, b, cおよびdが、それぞれ $0.25 \leq a \leq 0.65$, $0 \leq$

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$b \leq 0.2, 0.35 \leq c \leq 0.75, 0.03 \leq d \leq 0.3$ の範囲にあることを特徴とする情報記録用薄膜。

【請求項7】前記BおよびXの少なくとも一方が膜厚方向において濃度勾配を有することを特徴とする請求項1～6のいずれかに記載の情報記録用薄膜。

【請求項8】当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、その析出物が前記BおよびXの少なくとも一方で表わされる元素を含んでいる請求項1～6のいずれかに記載の情報記録用薄膜。

【請求項9】当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、高融点成分の少なくとも一部分が、当該薄膜の光入射側に非連続膜状に平均膜厚1～10nmの範囲で存在することを特徴とする請求項1, 2, 5および6のいずれかに記載の情報記録用薄膜。

【請求項10】当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、高融点成分の構成元素の原子数の和が、当該薄膜の構成元素の全原子数の和に対して10～50%の範囲にある請求項1, 2, 5および6のいずれかに記載の情報記録用薄膜。

【請求項11】当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、高融点成分含有量が膜厚方向において変化することを特徴とする請求項1, 2, 5および6のいずれかに記載の情報記録用薄膜。

【請求項12】当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、当該薄膜の平均組成を、元素単体または化合物組成の低融点成分Lと元素単体または化合物組成の高融点成分Hにより

$$L_j H_k \quad (6)$$

の式で表した時、 $20 \leq k / (j + k) \leq 40$

(7) である組成を基準組成とし、上記情報記録用薄膜を構成する各元素の膜中での含有量は前記式で決まる値±10原子%の範囲内にあることを特徴とする請求項1, 2, 5および6のいずれかに記載の情報記録用薄膜。

【請求項13】当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、高融点成分の融点が780°C以上である請求項1, 2, 5および6のいずれかに記載の情報記録用薄膜。

【請求項14】当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、高融点成分の融点と当該薄膜の残成分の融点との差が150°C以上である請求項1, 2, 5および6のいずれかに記載の情報記録用薄膜。

【請求項15】当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、高融点成分の析出物が、当該薄膜の内部に粒状または柱状に分布している請求項1, 2, 5および6のいずれかに記載の情報記録用薄膜。

報記録用薄膜。

【請求項16】当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、高融点成分の析出物の当該薄膜の膜面方向での最大外寸法が5nm以上、50nm以下である請求項1, 2, 5および6のいずれかに記載の情報記録用薄膜。

【請求項17】当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、高融点成分の析出物が、当該薄膜の両方の界面からその膜厚方向に柱状に延びており、析出物の膜厚方向の長さが5nm以上で、当該薄膜の膜厚の(1/2)以下である請求項1, 2, 5および6のいずれかに記載の情報記録用薄膜。

【請求項18】当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、高融点成分の析出物が、当該薄膜の一方の界面からその膜厚方向に柱状に延びており、前記析出物の膜厚方向の長さが10nm以上で、当該薄膜の膜厚以下である請求項1, 2, 5および6のいずれかに記載の情報記録用薄膜。

【請求項19】当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、高融点成分の析出物の膜厚方向の長さが10nm以上で、当該薄膜の膜厚以下である請求項1, 2, 5および6のいずれかに記載の情報記録用薄膜。

【請求項20】当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、隣接する2つの前記高融点成分の析出物の中心間を結ぶ直線が、当該薄膜の膜面方向でそれら析出物の間の領域を通る長さが20nm以上、90nm以下である請求項1, 2, 5および6のいずれかに記載の情報記録用薄膜。

【請求項21】当該薄膜の残成分より相対的に融点が高い高融点成分からなる多孔質の析出物を含んでおり、当該残成分が前記多孔質析出物の孔内に分布している請求項1, 2, 5および6のいずれかに記載の情報記録用薄膜。

【請求項22】当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、高融点成分の多孔質状析出物の孔の当該薄膜の膜面方向での最大孔寸法が80nm以下であり、隣接する2つの前記孔の間の領域の当該薄膜の膜面方向での最大壁厚さが20nm以下である請求項1, 2, 5および6のいずれかに記載の情報記録用薄膜。

【請求項23】当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、当該薄膜の残成分の融点が650°C以下である請求項1, 2, 5および6のいずれかに記載の情報記録用薄膜。

【請求項24】当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、当該薄膜の残成分の融点が250°C以下である請求項1, 2, 5および6のいずれかに記載の情報記録用薄膜。

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【請求項25】当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、当該薄膜の複素屈折率の実数部および虚数部の少なくとも一方が、光の照射によって照射前のそれに対して20%以上変化する請求項1, 2, 5および6のいずれかに記載の情報記録用薄膜。

【請求項26】基板上に直接または保護層を介して形成された、エネルギーービームの照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用薄膜において、当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、その析出物が当該薄膜の残成分からなる領域内に分布していることを特徴とする情報記録用薄膜。

【請求項27】前記高融点成分の析出物の当該薄膜の膜面方向での最大外寸法が5nm以上、50nm以下である請求項26に記載の情報記録用薄膜。

【請求項28】前記高融点成分の析出物が、当該薄膜の両方の界面からその膜厚方向に柱状に延びており、前記析出物の膜厚方向の長さが5nm以上で、当該薄膜の膜厚の(1/2)以下である請求項26に記載の情報記録用薄膜。

【請求項29】前記高融点成分の析出物が、当該薄膜の一方の界面からその膜厚方向に柱状に延びており、前記析出物の膜厚方向の長さが10nm以上で、当該薄膜の膜厚以下である請求項26に記載の情報記録用薄膜。

【請求項30】前記高融点成分の析出物の膜厚方向の長さが10nm以上で、当該薄膜の膜厚以下である請求項26に記載の情報記録用薄膜。

【請求項31】隣接する2つの前記高融点成分の析出物の中心間を結ぶ直線が、当該薄膜の膜面方向でそれら析出物の間の領域を通る長さが20nm以上、90nm以下である請求項26に記載の情報記録用薄膜。

【請求項32】基板上に直接または保護層を介して形成された、エネルギーービームの照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用薄膜において、

当該薄膜の残成分より相対的に融点が高い高融点成分からなる多孔質の析出物を含んでおり、当該薄膜の残成分が前記多孔質析出物の孔内に分布していることを特徴とする情報記録用薄膜。

【請求項33】前記高融点成分の多孔質状析出物の孔の当該薄膜の膜面方向での最大内寸法が80nm以下であり、隣接する2つの前記孔の間の領域の当該薄膜の膜面方向での最大壁厚さが20nm以下である請求項32に記載の情報記録用薄膜。

【請求項34】当該薄膜の残成分の融点が650°C以下である請求項26または32に記載の情報記録用薄膜。

【請求項35】当該薄膜の残成分の融点が250°C以下である請求項26または32に記載の情報記録用薄

膜。

【請求項36】当該薄膜の複素屈折率の実数部および虚数部の少なくとも一方が、光の照射によって照射前のそれに対して20%以上変化する請求項26または32に記載の情報記録用薄膜。

【請求項37】前記高融点成分の構成元素の原子数の和が、当該薄膜の全原子数の和に対して10~50%の範囲にある請求項26または32に記載の情報記録用薄膜。

【請求項38】平均組成を、元素単体または化合物組成の低融点成分Lと元素単体または化合物組成の高融点成分Hにより

$$L_j H_k \quad (6)$$

の式で表した時、 $20 \leq k / (j + k) \leq 40 \quad (7)$

である組成を基準組成とし、上記情報記録用薄膜を構成する各元素の膜中での含有量は前記式で決まる値±10原子%の範囲内にあることを特徴とする請求項26または32に記載の情報記録用薄膜。

【請求項39】前記高融点成分の融点が780°C以上である請求項26または32に記載の情報記録用薄膜。

【請求項40】前記高融点成分の融点と当該薄膜の残成分の融点との差が150°C以上である請求項26または32に記載の情報記録用薄膜。

【請求項41】前記BおよびXの少なくとも一方で表わされる元素がCrである請求項1, 2, 5および6のいずれかに記載の情報記録用薄膜。

【請求項42】前記BおよびXの少なくとも一方で表わされる元素がMoおよびSi, Pt, Co, Mn, Wである請求項1, 2, 5および6のいずれかに記載の情報記録用薄膜。

【請求項43】基板上に直接または保護層を介して形成された、エネルギーービームの照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用薄膜の製造方法であって、

基板上に直接または保護層を介して薄膜を形成する工程と、

前記薄膜にエネルギーービームを照射して前記薄膜中に高融点成分を生成または成長させる工程とを備えてなることを特徴とする情報記録用薄膜の製造方法。

【請求項44】基板上に直接または保護層を介して形成された、エネルギーービームの照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用薄膜の製造方法であって、

基板上に直接または保護層を介して高融点成分の材料あるいは高融点成分の組成に近い組成を持つ材料を被着させて島状の種結晶を形成する工程と、

前記種結晶の上に前記高融点成分と前記残成分とを含む材料を被着させ、前記高融点成分を選択的に前記種結晶上に成長させると共に、それら種結晶の間を埋めるよう前記残成分を成長させる工程とを備えてなることを特

徴とする情報記録用薄膜の製造方法。

【請求項45】基板上に直接または保護層を介して形成された、エネルギーービームの照射を受けて生じる原子配列変化によって情報を記録または再生する情報記録用薄膜の製造方法であって、

基板上に直接または保護層を介して相変化成分と高融点成分より成る膜の形成時に高融点成分の含有量を膜厚方向に変化させる工程とを備えてることを特徴とする情報記録用薄膜の製造方法。

【請求項46】請求項1～6, 26および32のいずれかに記載の情報記録用薄膜を記録層として備えた情報記録媒体。

【請求項47】請求項1～6, 26および32のいずれかに記載の情報記録用薄膜を超解像読み出し用のマスク層として備えた情報記録媒体。

【請求項48】請求項1～6, 26および32のいずれかに記載の情報記録用薄膜を超解像読み出し用の反射層として備えた情報記録媒体。

【請求項49】前記高融点成分の析出後の前記残成分の融点が650°C以下である請求項1～6, 26および32のいずれかに記載の情報記録用薄膜を備えた情報記録媒体。

【請求項50】前記反射層の反射率が60%以上である請求項1～6, 26および32のいずれかに記載の情報記録用薄膜を備えた情報記録媒体。

【請求項51】請求項1～6, 26および32のいずれかに記載の情報記録用薄膜を記録層または超解像読み出し用のマスク層として備え、かつ反射層側にSiを含む層と記録膜側にZnSを主成分とする層の2層構造の中間層を備えた情報記録媒体。

【請求項52】基板上に直接または保護層を介して形成された、エネルギーービームの照射を受けて生じる原子配列変化によって情報を記録または再生する情報記録用薄膜を記録層または超解像読み出し用のマスク層として備え、かつSi-Sn, Si-Ge, Si-In化合物の少なくとも1つ、またはこれに近い組成である反射層を備えた情報記録媒体。

【請求項53】基板上に直接または保護層を介して形成された、エネルギーービームの照射を受けて生じる原子配列変化によって情報を記録または再生する情報記録用薄膜を記録層または超解像読み出し用のマスク層として備え、かつ反射層の膜厚が、150nm以上300nm以下である特徴を持つ情報記録媒体。

【請求項54】基板上に直接または保護層を介して形成された、エネルギーービームの照射を受けて生じる原子配列変化によって情報を記録または再生する情報記録用薄膜を記録層または超解像読み出し用のマスク層として備え、かつ光入射側にSiO₂層と記録膜側にZnS-SiO₂層の2層構造の保護層を備えた情報記録媒体。

【請求項55】基板上に直接もしくは保護層を介して形

成され読み出し用ビームの照射を受けて超解像効果を生ずる超解像読み出し用薄膜であって、少なくとも相変化成分及び該相変化成分より融点が高い高融点成分を含み、高融点成分は析出していることを特徴とする超解像読み出し用薄膜。

【請求項56】前記高融点成分は柱状または塊状析出物として析出していることを特徴とする請求項55記載の超解像読み出し用薄膜。

【請求項57】前記高融点成分は多孔質状析出物として析出していることを特徴とする請求項55記載の超解像読み出し用薄膜。

【請求項58】基板上に直接もしくは保護層を介して形成され読み出し用ビームの照射を受けて超解像効果を生ずる超解像読み出し用薄膜であって、平均組成が一般式D_eE_fF_g

で表され、前記DはSn, Pb, Bi, Zn, Ga, Inから選ばれた少なくとも1つの元素、前記EはAs, B, C, N, O, S, Se, Si, Te, Ag, Al, Au, Ba, Be, Ca, Cd, Co, Cr, Cs, Cu, Fe, Ge, Hf, Hg, Ir, K, Li, Mg, Mn, Mo, Na, Nb, Ni, Os, Pd, Pt, Rb, Re, Rh, Ru, Sb, Sc, Sr, Ta, Ti, V, W, Y, Zrより成る群より選ばれた少なくとも1つの元素、前記Fは前記D及び前記Eで表される以外の少なくとも1つの元素を表し、前記e, f及びgの単位はいずれも原子パーセントで、それぞれ30≤e≤95, 5≤f≤50, 0≤g≤20の範囲にあることを特徴とする請求項55記載の超解像読み出し用薄膜。

【請求項59】平均組成を、元素単体または化合物組成の低融点成分Lと元素単体または化合物組成の高融点成分Hにより

$$L_j H_k \quad (6)$$

の式で表した時、20≤k/(j+k)≤40 (7)

である組成を基準組成とし、各元素の膜中での含有量は前記式で決まる値±10原子%の範囲内にあることを特徴とする請求項55に記載の超解像読み出し用薄膜。

【請求項60】低融点成分と高融点成分がいずれも金属または半金属元素を50原子%以上含むことを特徴とする請求項55に記載の超解像読み出し用薄膜。

【請求項61】凹凸によって情報が記録された透明基板上に請求項55に記載された超解像読み出し用薄膜を設け、その上に反射層を設けたことを特徴とする情報記録媒体。

【請求項62】凹凸によって情報が記録された透明基板と請求項55に記載された超解像読み出し用薄膜の間に保護層が設けられていることを特徴とする情報記録媒体。

【請求項63】請求項55に記載された超解像読み出し用薄膜と反射層の間に中間層が設けられていることを特徴とする情報記録媒体。

【請求項6 4】透明基板上に請求項5 5に記載された超解像読み出し用薄膜を設け、その上に情報記録膜を設け、さらにその上に反射層を設けたことを特徴とする情報記録媒体。

【請求項6 5】透明基板と請求項5 5に記載された超解像読み出し用薄膜の間に保護層が設けられていることを特徴とする情報記録媒体。

【請求項6 6】請求項5 5に記載された超解像読み出し用薄膜と情報記録膜の間、及び情報記録膜と反射層の間の少なくとも一方に中間層が設けられていることを特徴とする情報記録媒体。

【請求項6 7】請求項5 5に記載された超解像読み出し用薄膜を備えた情報記録媒体と、前記情報記録媒体にレーザ光を満たすことを特徴とする超解像読み出し用装置。

【請求項6 9】請求項5 5に記載の超解像読み出し用薄膜を備えた情報記録媒体と、前記情報記録媒体にレーザ光を照射して反射光を検出する光ヘッドとを備える超解像読み出し用装置において、レーザ光の出力を超解像読み出し用薄膜の最高温度となる領域でも膜全体は融解しない出力に設定する手段を有することを特徴とする超解像読み出し用装置。

【請求項7 0】基板上に直接または保護層を介して形成された、エネルギービームの照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用薄膜において、当該薄膜を有する情報記録用媒体を用いる情報の記録再生装置または媒体初期結晶化用装置においてレーザ光を繰り返し照射することにより、当該薄膜の残成分より相対的に融点が高い高融点成分が析出し、その析出物が当該薄膜の残成分からなる領域内に分布することを特徴とする情報記録用薄膜。

【請求項7 1】基板上に直接または保護層を介して形成された、エネルギービームの照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用薄膜を有する情報記録用媒体を用いる情報の記録再生方法または媒体初期結晶化用方法においてレーザ光を繰り返し照射することにより、当該薄膜の残成分より相対的に融点が高い高融点成分が析出し、その析出物が当該薄膜の残成分からなる領域内に分布させることを特徴とする情報の記録再生方法。

【請求項7 2】当該薄膜において、当該薄膜を有する情報記録用媒体を用いる情報の記録再生装置または媒体初期結晶化用装置においてレーザ光を繰り返し照射することにより、当該薄膜の残成分より相対的に融点が高い高融点成分が析出し、その析出物が当該薄膜の残成分からなる領域内に分布し、その析出物が前記BおよびXの少なくとも一方で表わされる元素を含むことを特徴とする請求項1～6のいずれかに記載の情報記録用薄膜。

【請求項7 3】基板上に直接または保護層を介して形成された、エネルギービームの照射を受けて生じる原子配

*レーザ光を照射して反射光を検出する光ヘッドとを備える超解像読み出し用装置において、超解像読み出し時の反射光の強度分布の乱れを検出する手段と、上記乱れの大きさに応じてレーザパワーを調節する手段を有することを特徴とする超解像読み出し用装置。

【請求項6 8】請求項5 5に記載の超解像読み出し用薄膜を備えた情報記録媒体と、前記情報記録媒体にレーザ光を照射して反射光を検出する光ヘッドとを備える超解像読み出し用装置において、

10 前記レーザ光はパルス光であり、レーザパルスの周期T、線速v、スポット径(λ/NA)、パルス幅xの関係が

$$0.4\lambda/NA \leq vT \leq 1.5\lambda/NA \quad (9)$$

(10)

列変化によって情報を記録・再生する情報記録用媒体の製造方法であって、基板上に保護層、記録膜または超解像読みだし膜、中間層、反射層を形成する工程と、これに別の基板または同様にして前記各層を形成した別の基板を貼り合わせる工程と前記媒体にエネルギービームを照射して前記薄膜中に高融点成分を生成または成長させる工程とを備えてなることを特徴とする情報記録用媒体の製造方法。

【請求項7 4】基板上に直接または保護層を介して形成された、エネルギービームの照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用媒体の製造方法であって、基板上に保護層を形成する工程と高融点成分の材料あるいは高融点成分の組成に近い組成を持つ材料を被着させて島状の種結晶を形成する工程と、前記種結晶の上に前記高融点成分と前記残成分とを含む

30 材料を被着させ、前記高融点成分を選択的に前記種結晶上に成長させると共に、それら種結晶の間を埋めるように前記残成分を成長させる工程と中間層、反射層を形成する工程と、これに別の基板または同様にして前記各層を形成した別の基板を貼り合わせる工程と備えてなることを特徴とする情報記録用媒体の製造方法。

【請求項7 5】基板上に直接または保護層を介して形成された、エネルギービームの照射を受けて生じる原子配列変化によって情報を記録または再生する情報記録用媒体の製造方法であって、基板上に保護層を形成する工程と、相変化成分と高融点成分より成る膜の形成を行ないつつ高融点成分の含有量を膜厚方向に変化させる工程と、中間層、反射層を形成する工程と、これに別の基板または同様にして前記各層を形成した別の基板を貼り合わせる工程を備えてることを特徴とする情報記録用媒体の製造方法。

【発明の詳細な説明】

【0001】

【産業上の利用分野】この発明は、情報記録用薄膜およびその製造方法ならびに情報記録媒体に関し、さらに詳しく言えば、例えば映像や音声などのアナログ信号をF

M変調して得た情報や、電子計算機のデータやファクシミリ信号やディジタル・オーディオ信号などのディジタル情報をレーザ光、電子線等のエネルギーービームによってリアルタイムで記録・再生することができる情報記録用薄膜または超解像読み出し用薄膜、およびその製造方法ならびに、その情報記録用薄膜または超解像読み出し用薄膜を用いた情報記録媒体に関する。

【0002】

【従来の技術】レーザ光を照射して薄膜（記録膜）に情報を記録する原理は種々知られているが、そのうちで膜材料の相転移（相変化とも呼ばれる）やフォトドーケーニングなど、レーザ光の照射による原子配列変化を利用するものは、薄膜の変形をほとんど伴わないので、2枚のディスク部材を直接貼り合わせて両面ディスク構造の情報記録媒体が得られるという長所を持つ。また、GeSbTe系やInSbTe系の記録膜では、情報の書き換えを行なうことができる利点がある。

【0003】しかし、この種の記録膜では、ピットポジション記録においては10⁵回、ピットエッジ記録においては10⁴回を越える多数回の書き換えを行なうと、記録膜の流動により書き換え特性が低下するため、記録膜の流動を防止する方法が研究されている。記録膜の流動は、記録時のレーザ照射により、記録膜が流動し、保護層や中間層の熱膨張による変形により、記録膜が少しづつ押されて生じる。

【0004】例えば、特開平4-228127号公報には、記録膜のマイクロセル化により流動を防止する方法が開示され、文献 T. Ohta et al. "Optical Data Storage" 89 Proc. SPIE, 1078, 27 (1989) には、記録膜を薄くして熱容量を下げ且つ隣接する層との付着力の影響が大きくなるのを利用して記録膜の流動を防止する方法が開示されている。

【0005】映像信号や音声信号などをFM変調したアナログ情報信号や、電子計算機のデータ、ファクシミリ信号、ディジタルオーディオ信号などのディジタル情報信号を基板表面に凹凸として転写した光ディスクや、レーザ光、電子線等の記録用ビームによって信号やデータをリアルタイムで記録することができる情報の記録用薄膜等を有する光ディスクにおいては、信号再生分解能は、ほとんど再生光学系の光源の波長λと対物レンズの開口数NAで決まり、記録マーク周期2NA/λが読み取り限界である。

【0006】高記録密度化のための手法としては、相変化により反射率が変化する媒体を用いて凹凸で記録されたデータを再生する方法が特開平3-292632号公報に記載され、また、相変化記録膜に記録されたデータを高密度再生するための溶融マスク層を持つ媒体が特開平5-73961号公報に記載されている。

【0007】なお、本明細書では、結晶-非晶質間の相変化ばかりでなく、融解（液相への変化）と再結晶化、

結晶状態-結晶状態間の相変化も含むものとして「相変化」という用語を使用する。

【0008】

【発明が解決しようとする課題】従来の記録膜はいずれも、書き換え可能な相転移型の記録膜として用いる場合、①書き換え可能回数が十分でない、②書き換え可能回数を多くすると結晶化速度が遅くなる、③書き換え可能回数を多くすると再生信号強度が十分でなくなる、などの問題を有している。

10 【0009】そこで、この発明の目的は、良好な記録・再生特性を保持しながら従来より多数回の書き換えが可能である情報記録用薄膜およびその製造方法ならびにその薄膜を用いた情報記録媒体を提供することにある。

【0010】また、特開平3-292632号公報に記載の方法は、Sb₂Se₃膜を用い、読み出し光の走査スポット内で部分的に相変化させて反射率を変え、高反射率領域内の位相ピットを読みだす。この方法では、上記の膜の融点が高温のため、レーザの照射パワーが高く、位相ピットで情報を記録した光ディスク以外の相変化型光ディスク、光磁気ディスクなどに適用できない。さらに、多数回の読み出しを繰り返すと膜の流動、偏析が少しづつ生じ、超解像読み出し可能回数が少ない、などの欠点がある。また、特開平5-73961号公報に記載の媒体は、溶融マスク層を用い、読み出し光の走査スポット内で部分的に溶融して反射率を変え、見かけ上スポットサイズを小さくする。この媒体では、融点が低い溶融マスク層を用いており、粘度が低いため、多数回の読み出しを繰り返すと膜の流動、偏析が少しづつ生じ、超解像読み出し可能回数が少ない、などの欠点がある。

【0011】そこで、この発明の他の目的は、上記した従来技術の欠点を解消し、映像信号や音声信号などのアナログ情報信号や、電子計算機のデータ、ファクシミリ信号、ディジタルオーディオ信号などのディジタル情報信号が凹凸により記録された光ディスクや相変化型光ディスク、光磁気ディスクなどに適用でき、流動、偏析を防止することにより、超解像読み出し可能回数を増大した超解像読み出し用薄膜を提供することにある。

【0012】

【課題を解決するための手段】

(1) この発明の第1の情報記録用薄膜は、基板上に直接または保護層を介して形成された、エネルギーービームの照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用薄膜において、前記情報記録用薄膜の膜厚方向の平均組成が、一般式

$$S_{b_x}T_{e_y}A_pB_qC_r \quad (1)$$

で表わされ、前記AはGeおよびInからなる第1群から選ばれた少なくとも一つの元素、前記Bはランタノイド元素(La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb)およびL

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u) およびAg, Ba, Co, Cr, Ni, Pt, Si, Sr, Au, Cd, Cu, Li, Mo, Mn, Zn, Al, Fe, Pb, Na, Cs, Ga, Pd, Bi, Sn, Ti およびVからなる第2群から選ばれた少なくとも一つの元素、前記CはSb, Te および前記AおよびBで表わされる元素以外の少なくとも一つの元素を表わし、前記x, y, p, q およびrの単位はいずれも原子パーセントで、それぞれ $2 \leq x \leq 41$, $25 \leq y \leq 75$, $0.1 \leq p \leq 60$, $3 \leq q \leq 40$, $0.1 \leq r \leq 30$ の範囲にあることを特徴とする。

【0013】(2) この発明の第2の情報記録用薄膜は、基板上に直接または保護層を介して形成された、エネルギー beams の照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用薄膜において、前記情報記録用薄膜の膜厚方向の平均組成が、一般式

$$Sb_xTe_yA_pB_q \quad (2)$$

で表わされ、前記AはGe およびIn からなる第1群から選ばれた少なくとも一つの元素、前記Bはランタノイド元素およびAg, Ba, Co, Cr, Ni, Pt, Si, Sr, Au, Cd, Cu, Li, Mo, Mn, Zn, Al, Fe, Pb, Na, Cs, Ga, Pd, Bi, Sn, Ti およびVからなる第2群から選ばれた少なくとも一つの元素を表わし、前記x, y, d およびeの単位はいずれも原子パーセントで、それぞれ $2 \leq x \leq 41$, $25 \leq y \leq 75$, $0.1 \leq p \leq 60$, $3 \leq q \leq 40$ の範囲にあることを特徴とする。

【0014】これは、前記第1の情報記録用薄膜の前記Cで表わされる元素を除いたものに相当する。

【0015】(3) この発明の第3の情報記録用薄膜は、基板上に直接または保護層を介して形成された、エネルギー beams の照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用薄膜において、前記情報記録用薄膜の膜厚方向の平均組成が、一般式

$$Sb_xTe_yB_qCr \quad (3)$$

で表わされ、前記Bはランタノイド元素およびAg, Ba, Co, Cr, Ni, Pt, Si, Sr, Au, Cd, Cu, Li, Mo, Mn, Zn, Al, Fe, Pb, Na, Cs, Ga, Pd, Bi, Sn, Ti およびVからなる群から選ばれた少なくとも一つの元素、前記CはSb, Te および前記Bで表わされる元素以外の少なくとも一つの元素を表わし、前記x, y, e およびfの単位はいずれも原子パーセントで、それぞれ $2 \leq x \leq 41$, $25 \leq y \leq 75$, $3 \leq q \leq 40$, $0.1 \leq r \leq 30$ の範囲にあることを特徴とする。

【0016】これは、前記第1の情報記録用薄膜の前記Aで表わされる元素を除いたものに相当する。

【0017】(4) この発明の第4の情報記録用薄膜は、基板上に直接または保護層を介して形成された、エネルギー beams の照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用薄膜において、前

記情報記録用薄膜の膜厚方向の平均組成が、一般式

$$Sb_xTe_yB_q \quad (4)$$

で表わされ、前記Bはランタノイド元素およびAg, Ba, Co, Cr, Ni, Pt, Si, Sr, Au, Cd, Cu, Li, Mo, Mn, Zn, Al, Fe, Pb, Na, Cs, Ga, Pd, Bi, Sn, Ti およびVからなる群から選ばれた少なくとも一つの元素を表わし、前記x, y およびeの単位はいずれも原子パーセントで、それぞれ $2 \leq x \leq 41$, $25 \leq y \leq 75$, $3 \leq q \leq 40$ の範囲にあることを特徴とする。

【0018】これは、前記第1の情報記録用薄膜の前記AおよびCで表わされる元素を除いたものに相当する。

【0019】(5) この発明の情報記録用薄膜は、基板上に直接または保護層を介して形成された、エネルギー beams の照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用薄膜において、前記情報記録用薄膜の平均組成が、一般式

$$(Ge_aSb_bTe_c)_{1-d}X_d \quad (5)$$

で表わされ、前記XはCr およびAg, Ba, Co, Ni, Pt, Si, Sr, Au, Cd, Cu, Li, Mo, Mn, Zn, Al, Fe, Pb, Na, Cs, Ga, Pd, Bi, Sn, Ti, V, In およびランタノイド元素からなる少なくとも一つの元素を表わし、前記a, b, c およびdが、それぞれ $0.02 \leq a \leq 0.19$, $0.04 \leq b \leq 0.4$, $0.5 \leq c \leq 0.75$, $0.03 \leq d \leq 0.3$ の範囲にあることを特徴とする。

【0020】(6) この発明の情報記録用薄膜は、基板上に直接または保護層を介して形成された、エネルギー beams の照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用薄膜において、前記情報記録用薄膜の平均組成が、一般式

$$(Ge_aSb_bTe_c)_{1-d}X_d \quad (5)$$

で表わされ、前記XはCr およびAg, Ba, Co, Ni, Pt, Si, Sr, Au, Cd, Cu, Li, Mo, Mn, Zn, Al, Fe, Pb, Na, Cs, Ga, Pd, Bi, Sn, Ti, V, In およびランタノイド元素からなる少なくとも一つの元素を表わし、前記a, b, c およびdが、それぞれ $0.25 \leq a \leq 0.65$, $0 \leq b \leq 0.2$, $0.35 \leq c \leq 0.75$, $0.03 \leq d \leq 0.3$ の範囲にあることを特徴とする。

【0021】(7) 前記1～6のいずれかに記載の情報記録用薄膜において、前記BまたはXが膜厚方向において濃度匀配を有することを特徴とする。

【0022】(8) 前記1～6のいずれかに記載の情報記録用薄膜において、当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、その析出物が前記Bまたは前記Xで表わされる元素を含んでいることを特徴とする。

【0023】(9) 前記2, 5 および6のいずれかに記

載の情報記録用薄膜において、当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、高融点成分の少なくとも一部分が、当該薄膜の光入射側に非連続膜状に平均膜厚1～10nmの範囲で存在することを特徴とする。

【0024】(10) 前記2, 5および6のいずれかに記載の情報記録用薄膜において、当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、高融点成分の構成元素の原子数の和が、当該薄膜の構成元素の全原子数の和に対して10～50%の範囲にあることを特徴とする。

【0025】(11) 前記2, 5および6のいずれかに記載の情報記録用薄膜において、当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、高融点成分含有量が膜厚方向において変化することを特徴とする。

【0026】(12) 前記2, 5および6のいずれかに記載の情報記録用薄膜において、当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、当該薄膜の平均組成を元素単体または化合物組成の低融点成分Lと元素単体または化合物組成の高融点成分Hにより

$$L_j H_k \quad (6)$$

の式で表した時、 $20 \leq k / (j + K) \leq 40$ (7)

である組成を基準組成とし、各元素の膜中での含有量は前記式で決まる値±10原子%の範囲内にあることを特徴とする。

【0027】(13) 前記2, 5および6のいずれかに記載の情報記録用薄膜において、当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、高融点成分の融点が780°C以上であることを特徴とする。

【0028】(14) 前記2, 5および6のいずれかに記載の情報記録用薄膜において、当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、高融点成分の融点と当該薄膜の残成分の融点との差が150°C以上であることを特徴とする。

【0029】(15) 前記2, 5および6のいずれかに記載の情報記録用薄膜において、当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、高融点成分の析出物が、当該薄膜の内部に粒状または柱状に分布していることを特徴とする。

【0030】(16) 前記2, 5および6のいずれかに記載の情報記録用薄膜において、当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、高融点成分の析出物の当該薄膜の膜面方向での最大外寸法が5nm以上、50nm以下であることを特徴とする。

【0031】(17) 前記2, 5および6のいずれかに記載の情報記録用薄膜において、当該薄膜の残成分より

相対的に融点が高い高融点成分からなる析出物を含んでおり、高融点成分の析出物が、当該薄膜の両方の界面からその膜厚方向に柱状に延びており、析出物の膜厚方向の長さが5nm以上で、当該薄膜の膜厚の(1/2)以下であることを特徴とする。

【0032】(18) 前記2, 5および6のいずれかに記載の情報記録用薄膜において、当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、高融点成分の析出物が、当該薄膜の一方の界面からその膜厚方向に柱状に延びており、析出物の膜厚方向の長さが10nm以上で、当該薄膜の膜厚以下である請求項9または10に記載の情報記録用薄膜。

【0033】(19) 前記2, 5および6のいずれかに記載の情報記録用薄膜において、当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、高融点成分の析出物の膜厚方向の長さが10nm以上で、当該薄膜の膜厚以下であることを特徴とする。

【0034】(20) 前記2, 5および6のいずれかに記載の情報記録用薄膜において、当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、隣接する2つの高融点成分の析出物の中心間を結ぶ直線が、当該薄膜の膜面方向でそれら析出物の間の領域を通る長さが15nm以上、70nm以下であることを特徴とする。

【0035】(21) 前記2, 5および6のいずれかに記載の情報記録用薄膜において、当該薄膜の残成分より相対的に融点が高い高融点成分からなる多孔質の析出物を含んでおり、当該残成分が前記多孔質析出物の孔内に分布していることを特徴とする。

【0036】(22) 前記2, 5および6のいずれかに記載の情報記録用薄膜において、当該薄膜の残成分より相対的に融点が高い高融点成分からなる多孔質の析出物を含んでおり、高融点成分の多孔質状析出物の孔の当該薄膜の膜面方向での最大孔寸法が80nm以下であり、隣接する2つの前記孔の間の領域の当該薄膜の膜面方向での最大壁厚さが20nm以下であることを特徴とする。

【0037】(23) 前記2, 5および6のいずれかに記載の情報記録用薄膜において、当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、当該薄膜の残成分の融点が650°C以下であることを特徴とする。

【0038】(24) 前記2, 5および6のいずれかに記載の情報記録用薄膜において、当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、当該薄膜の残成分の融点が250°C以下であることを特徴とする。

【0039】(25) 前記2, 5および6のいずれかに記載の情報記録用薄膜において、当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んで

おり、当該薄膜の複素屈折率の実数部および虚数部の少なくとも一方が、光の照射によって照射前のそれに対して20%以上変化することを特徴とする。

【0040】(26) 基板上に直接または保護層を介して形成された、エネルギーービームの照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用薄膜において、当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、その析出物が当該薄膜の残成分からなる領域内に分布していることを特徴とする。

【0041】(27) 前記26に記載の情報記録用薄膜において、前記高融点成分の析出物の当該薄膜の膜面方向での最大外寸法が5nm以上、50nm以下であることを特徴とする。

【0042】(28) 前記26に記載の情報記録用薄膜において、前記高融点成分の析出物が、当該薄膜の両方の界面からその膜厚方向に柱状に延びており、前記析出物の膜厚方向の長さが5nm以上で、当該薄膜の膜厚の(1/2)以下であることを特徴とする。

【0043】(29) 前記26に記載の情報記録用薄膜において、前記高融点成分の析出物が、当該薄膜の一方の界面からその膜厚方向に柱状に延びており、前記析出物の膜厚方向の長さが10nm以上で、当該薄膜の膜厚以下であることを特徴とする。

【0044】(30) 前記26に記載の情報記録用薄膜において、前記高融点成分の析出物の膜厚方向の長さが10nm以上で、当該薄膜の膜厚以下であることを特徴とする。

【0045】(31) 前記26に記載の情報記録用薄膜において、隣接する2つの前記高融点成分の析出物の中心間を結ぶ直線が、当該薄膜の膜面方向でそれら析出物の間の領域を通る長さが15nm以上、70nm以下であることを特徴とする。

【0046】(32) 基板上に直接または保護層を介して形成された、エネルギーービームの照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用薄膜において、当該薄膜の残成分より相対的に融点が高い高融点成分からなる多孔質の析出物を含んでおり、当該薄膜の残成分が前記多孔質析出物の孔内に分布していることを特徴とする情報記録用薄膜。

【0047】(33) 前記32に記載の情報記録用薄膜において、前記高融点成分の多孔質状析出物の孔の当該薄膜の膜面方向での最大内寸法が80nm以下であり、隣接する2つの前記孔の間の領域の当該薄膜の膜面方向での最大壁厚さが20nm以下であることを特徴とする。

【0048】(34) 前記26または32に記載の情報記録用薄膜において、当該薄膜の残成分の融点が650°C以下であることを特徴とする。

【0049】(35) 前記32または32に記載の情報

記録用薄膜において、当該薄膜の残成分の融点が250°C以下であることを特徴とする。

【0050】(36) 前記26または32のいずれかに記載の情報記録用薄膜において、当該薄膜の複素屈折率の実数部および虚数部の少なくとも一方が、光の照射によって照射前のそれに対して20%以上変化することを特徴とする。

【0051】(37) 前記26または32のいずれかに記載の情報記録用薄膜において、前記高融点成分の構成元素の原子数の和が、当該薄膜の全原子数の和に対して10~50%の範囲にあることを特徴とする。

【0052】(38) 前記26または32のいずれかに記載の情報記録用薄膜において、平均組成を元素単体または化合物組成の低融点成分Lと元素単体または化合物組成の高融点成分Hにより

$$L_j H_k \quad (6)$$

の式で表した時、 $20 \leq k / (j + K) \leq 40$ (7)

である組成を基準組成とし、各元素の膜中での含有量は前記式で決まる値±10原子%の範囲内にあることを特徴とする。

【0053】(39) 前記26または32のいずれかに記載の情報記録用薄膜において、前記高融点成分の融点が780°C以上であることを特徴とする。

【0054】(40) 前記26または32のいずれかに記載の情報記録用薄膜において、前記高融点成分の融点と当該薄膜の残成分の融点との差が150°C以上であることを特徴とする。

【0055】(41) 前記2, 5および6のいずれかに記載の情報記録用薄膜において、当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、前記Bまたは前記Xで表わされる元素がMoおよびSi, Pt, Co, Mn, Wであることが好ましく、Crであることが特に好ましい。

【0056】(42) 基板上に直接または保護層を介して形成された、エネルギーービームの照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用薄膜の製造方法において、基板上に直接または保護層を介して薄膜を形成する工程と、前記薄膜にエネルギーービームを照射して前記薄膜中に高融点成分を生成または成長させる工程とを備えてなることを特徴とする。

【0057】(43) 基板上に直接または保護層を介して形成された、エネルギーービームの照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用薄膜の製造方法において、基板上に直接または保護層を介して高融点成分の材料あるいは高融点成分の組成に近い組成を持つ材料を被着させて島状の種結晶を形成する工程と、前記種結晶の上に前記高融点成分と前記残成分とを含む材料を被着させ、前記高融点成分を選択的に前記種結晶上に成長させると共に、それら種結晶の間を埋めるように前記残成分を成長させる工程とを備えてなる

ことを特徴とする。

【0058】前記島状の種結晶を形成するための膜の平均膜厚は、1nm以上、10nm以下が好ましい。1nm未満であると高融点成分を成長させる効果が小さく、10nmを越えるとノイズ増大の原因となる。

【0059】この方法では、高融点成分は情報記録用薄膜の片側の界面からその内部に向かって成長しやすい。

【0060】前記第1および第2の情報記録用薄膜の製造方法では、成膜するに真空蒸着、ガス中蒸着、スパッタリング、イオンビーム蒸着、イオンプレーティング、電子ビーム蒸着など、公知の方法を用いることができるが、スパッタリングを用いるのが好ましい。

【0061】スパッタリングの場合、記録用薄膜の組成のターゲットによってスパッタする方法では、膜中での均一性が良くノイズを低くすることができる。一方、高融点成分の組成のターゲットと残成分の組成のターゲットによる回転同時スパッタ法では、高融点成分の析出を早めることができ、書き換え可能回数を延ばすのに有効である。

【0062】(44) 基板上に直接または保護層を介して形成された、エネルギービームの照射を受けて生じる原子配列変化によって情報を記録または再生する情報記録用薄膜の製造方法において、基板上に直接または保護層を介して相変化成分と高融点成分より成る膜の形成時に高融点成分の含有量を膜厚方向に変化させる工程を備えることを特徴とする。

【0063】(45) 前記1～6、26および32のいずれかに記載の情報記録用薄膜を記録層として備えた情報記録媒体であることを特徴とする。

【0064】(46) 前記1～6、26および32のいずれかに記載の情報記録用薄膜を超解像読出し用のマスク層として備えた情報記録媒体であることを特徴とする。

【0065】(47) 前記1～6、26および32のいずれかに記載の情報記録用薄膜を超解像読出し用の反射層として備えた情報記録媒体であることを特徴とする。

【0066】(48) 前記高融点成分の析出後の前記残成分の融点が650°C以下である、前記1～6、26および32のいずれかに記載の情報記録媒体を備えた情報記録媒体であることを特徴とする。

【0067】(49) 前記1～6、26および32のいずれか47または48に記載の情報記録用薄膜を超解像読出し用の反射層として備えた情報記録媒体において、前記反射層の反射率が60%以上であることを特徴とする。

【0068】(50) 基板上に直接または保護層を介して形成された、エネルギービームの照射を受けて生じる原子配列変化によって情報を記録または再生する情報記録媒体において、前記1～6、26および32のいずれかに記載の情報記録用薄膜を記録層または超解像読出し

用のマスク層として備え、かつ反射層側にSiO₂層と記録膜側にZnS-SiO₂層の2層構造の中間層を備えることを特徴とする。

【0069】(51) 基板上に直接または保護層を介して形成された、エネルギービームの照射を受けて生じる原子配列変化によって情報を記録または再生する情報記録媒体において、基板上に直接または保護層を介して形成された、エネルギービームの照射を受けて生じる原子配列変化によって情報を記録または再生する情報記録用薄膜を記録層または超解像読出し用のマスク層として備え、かつSi-Sn、Si-Ge、Si-In化合物の少なくとも1つ、またはこれに近い組成である反射層を備えることを特徴とする。

【0070】(52) 基板上に直接または保護層を介して形成された、エネルギービームの照射を受けて生じる原子配列変化によって情報を記録または再生する情報記録媒体において、基板上に直接または保護層を介して形成された、エネルギービームの照射を受けて生じる原子配列変化によって情報を記録または再生する情報記録用薄膜を記録層または超解像読出し用のマスク層として備え、かつ反射層の膜厚が、150nm以上300nm以下である特徴を持つ。

【0071】(53) 基板上に直接または保護層を介して形成された、エネルギービームの照射を受けて生じる原子配列変化によって情報を記録または再生する情報記録媒体において、基板上に直接または保護層を介して形成された、エネルギービームの照射を受けて生じる原子配列変化によって情報を記録または再生する情報記録用薄膜を記録層または超解像読出し用のマスク層として備え、かつ光入射側にSiO₂層と記録膜側にZnS-SiO₂層の2層構造の保護層を備えることを特徴とする。

【0072】(54) 保護層2および中間層4の材料は、ZnS-SiO₂、Si-N系材料、Si-O-N系材料、SiO₂、SiO、Ta₂O₅、TiO₂、Al₂O₃、Y₂O₃、CeO、La₂O₃、In₂O₃、GeO、GeO₂、PbO、SnO、SnO₂、Bi₂O₃、TeO₂WO₂、WO₃、Sc₂O₃、ZrO₂などの酸化物、TaN、AlN、Si₃N₄、Al-Si-N系材料(例えばAl₁Si₂N₂)などの窒化物、ZnS、Sb₂S₃、CdS、In₂S₃、Ga₂S₃、GeS、SnS₂、PbS、Bi₂S₃、などの硫化物、SnSe₂、Sb₂Se₃、CdSe、ZnSe、In₂Se₃、Ga₂Se₃、GeSe、GeSe₂、SnSe、PbSe、Bi₂Se₃などのセレン化物、CeF₃、MgF₂、CaF₂などの弗化物、あるいはSi、Ge、TiB₂、B₄C、B、C、または、上記の材料に近い組成のものを用いるのが好ましい。また、これらの混合材料の層やこれらの多重層でもよい。

【0073】多重層の場合、ZnSを70モル%以上含

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む材料、例えばZnS-SiO₂と、Si, Geのうちの少なくとも一者を70原子%以上含む材料、例えばSi、あるいはSiの酸化物、例えばSiO₂との2層膜が好ましい。この場合、記録感度低下を防ぐため、ZnS-SiO₂層の方を記録膜側に設け、その厚さを3nm以上とする。また、SiO₂層の低熱膨張係数による記録膜流動抑制効果を発揮するために、厚さ10nm以下が好ましい。この2層膜は保護層2の代わりに設けると好ましいが、中間層4の代わりに設けてもよい。保護層2の代わりとしてはSiO₂層の厚さが50nm以上250nm以下が好ましい。中間層の代わりに2層膜を設ける場合は、SiO₂層の膜厚は10nm以上80nm以下が好ましい。これらの2層膜を設けることは、本発明の記録膜を用いる場合だけではなく、他の相変化記録膜を用いる場合にも好ましい。

【0074】中間層4の屈折率が1.7以上、2.3以下の範囲にある場合、膜厚が3nm以上、100nm以下、および180nm以上、400nm以下が好ましい。

【0075】反射層5の材料としては、Al-Ti、Si-Ge混合材料が、記録マーク部分の光吸収率を記録マーク以外の部分の光吸収率より小さくできるので、光吸収率差による消え残りを防止でき、さらに書き換え可能回数が低下せず、好ましい。Geの含有量は10原子%以上80原子%以下が書き換え可能回数が低下が生じにくく、好ましい。

【0076】次いで、Si-SnまたはSi-In混合材料、あるいはこれら混合材料の2種以上の混合材料でも同様の結果が得られ、好ましい。これらの反射層材料は、本発明の相変化膜ばかりでなく、他の相変化膜を用いる場合の反射層材料として用いても、従来のものに比べて、書き換え可能回数が低下しないため好ましい。

【0077】さらに、Si, Ge, C, Au, Ag, Cu, Al, Ni, Fe, Co, Cr, Ti, Pd, Pt, W, Ta, Mo, Sbの元素単体、またはこれらを主成分とする合金、あるいはこれら同志の合金よりなる層を用いてもよいし、それらの層よりなる多重層を用いてもよいし、これらと酸化物などの他の物質との複合層などを用いてもよい。

【0078】この実施例では、表面に直接、トラッキングガイドなどの凹凸を形成したポリカーボネート基板1を用いているが、その代わりに、ポリオレフィン、エポキシ、アクリル樹脂、紫外線硬化樹脂層を表面に形成した化学強化ガラスなどを用いてもよい。

【0079】中間層4、反射層5および保護層2の一部を省略した単純積層構造、例えば基板1/保護層2/記録膜3、基板1/記録膜3/中間層4、基板1/記録膜3/反射層5などの構成でも、従来のものに比べると、多数回書き換えを行なってもノイズ上昇が少なく、良好な結果が得られ、好ましい。

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【0080】以上述べたように、この実施例の情報記録用薄膜は、記録・再生・消去特性を良好に保ちながら、従来より多数回の書き換えが可能である。また、記録・消去に用いるレーザ光のパワーが低くてよいという利点もある。

【0081】(55)超解像読み出し用ビームの照射を受けて超解像効果を生ずる本発明の超解像読み出し用薄膜は、相変化成分及び析出した高融点成分を含むことを特徴とする。超解像読み出し用薄膜は、基板上に直接もしくは無機物及び有機物のうち少なくとも一者からなる保護層を介して形成される。

【0082】(56)相変化成分より相対的に融点が高い高融点成分は、柱状または塊状析出物として、あるいは多孔質状析出物として析出している。

【0083】(57)超解像読み出し用薄膜の平均組成は、次の一般式で表されるものとができる。

【0084】D_eE_fF_g (8)

ここで、前記EはSn, Pb, Bi, Zn, Ga, Inから選ばれた少なくとも1つの元素、前記EはAs, B, C, N, O, S, Se, Si, Te, Ag, Al, Au, Ba, Be, Ca, Cd, Co, Cr, Cs, Cu, Fe, Ge, Hf, Hg, Ir, K, Li, Mg, Mn, Mo, Na, Nb, Ni, Os, Pd, Pt, Rb, Re, Rh, Ru, Sb, Sc, Sr, Ta, Ti, V, W, Y, Zrより成る群より選ばれた少なくとも1つの元素を表し、前記Fは前記D及び前記Eで表される以外の少なくとも1つの元素を表し、例えは、Tl, Br, Cl, F, H, I, P等とができる。また、前記e, f及びgの単位はいずれも原子ペーセントで、それぞれ30≤e≤95, 5≤f≤50, 0≤g≤20の範囲にあることが好ましい。さらに、40≤e≤87, 13≤f≤40, 0≤g≤10の範囲にあることがより好ましい。

【0085】前記Fで表される元素は、例えは、前記D及びEで表される元素がそれぞれSn及びTeであれば、Sn及びTe以外の元素であればよい。また、前記D, D' (前記Dが上記Sn, ZnのようにD, D' 2元素の場合)、E, Fの組合せにおいて、D-E, E-F, D'-Eの組合せからできる高融点成分が共晶点をもたないか、共晶点をもってしてもD, D-D'の融点より150℃以上融点が高いことが好ましい。

【0086】(58)超解像読み出し用薄膜は、また、平均組成が次の一般式で表されるものを使用することができる。

【0087】S_eP_MN_gO_s (11)

ここで、前記MはIn, Sb, Bi, Te, Au, B, Cs, Sn, Tl, S, Ge, Fe, Znから選ばれた少なくとも1つの元素、前記NはAs, C, N, O, Si, Ag, Al, Ba, Be, Ca, Cd, Co, Cr, Cu, Hf, Hg, Ir, K, Li, Mg, Mn,

Mo, Na, Nb, Ni, Os, Pd, Pt, Rb, Re, Rh, Ru, Sc, Sr, Ta, Ti, V, W, Y, Zr, Pb, Ga, U及び、Se及び前記Mで表される元素以外の少なくとも1つの元素を表す。前記OはSe及び前記M及び前記Nで表される以外の少なくとも1つの元素を表し、例えばBr, Cl, F, H, I, Pとすることができます。また、前記p, q, r及びsの単位はいずれも原子パーセントで、それぞれ $40 \leq p \leq 95$ 、 $0 \leq q \leq 55$ 、 $5 \leq r \leq 50$ 、 $0 \leq s \leq 20$ の範囲にあることが好ましく、 $50 \leq p \leq 80$ 、 $0 \leq q \leq 40$ 、 $10 \leq r \leq 40$ 、 $0 \leq s \leq 10$ の範囲にあることが*

$$20 \leq k / (j+k) \leq 40$$

例えば、超解像読み出し用膜の基準組成が(GeS₂Te₄)₈₀(Cr₄Te₅)₂₀である場合、式(7)のLはGeS₂Te₄、HはCr₄Te₅であって、k/(j+k)は20である。ここで各元素の原子%は、それぞれ、LのGeは11%、Sbは23%、Teは46%、HのCrは9%、Teは11%である。そこで、式(7)で決まる値±10原子%の範囲はLのGeは1~21%、Sbは13~33%、Teは36~56%、HのCrは0~19%、Teは1~21%である。

【0090】(60) 低融点成分と高融点成分は、いずれも金属または半金属元素を50原子%以上含むことが好ましく、65原子%以上含むことがより好ましい。

【0091】(61) 上記式(8)および(11)の組成は相変化記録膜としても使用でき、超解像読み出し薄膜を用いない記録媒体の相変化記録膜としても使用できる。この記録膜を使用した場合、結晶化と非晶質化で反射率差の大きな媒体を作製できる。

【0092】高融点成分の原子数の和は、超解像読み出し膜の構成元素の全原子数の和に対する割合で10~50%の範囲であることが好ましく、20~40%の範囲であることがより好ましい。

【0093】(62) 高融点成分と相変化成分の組み合せでは、それぞれの成分中に同じ元素が30原子%以上、80原子%以下の範囲で存在することが好ましい。

【0094】高融点成分の融点は、析出後の残成分である相変化成分の融点より150°C以上高いことが好ましい。

【0095】(63) 高融点成分の平均組成は、下記のA群のうち少なくとも一者、もしくはこれに近い組成あるいは、融点800°C以上の化合物とすることができます。ここで、これに近い組成とは、列挙した組成からのずれが±10原子%の範囲内にあるものを指す(以下、同じ)。例えば、BaPd₂の場合、それぞれの元素の原子%は、Baは33%、Pdは67%である。そこで、組成BaPd₂からのずれが±10原子%の範囲は、Baは23~43%、Pdは57~77%である。

【0096】<A群>BaPd₂, BaPd₅, NdPd, NdPd₃, NdPd₅, Nd₇Pt₃, Nd₃Pt

*より好ましい。

【0088】(59) 超解像読み出し用薄膜の平均組成を、元素単体または化合物組成の低融点成分Lと元素単体または化合物組成の高融点成分Hより、次式で表すとき、

$$L_j H_k \quad (6)$$

下式(7)の範囲の組成を基準組成とし、上記薄膜を構成する各元素の膜中での含有量は、式(7)で決まる値±10原子%の範囲内にあることが好ましく、±5原子%の範囲内にあるとより好ましい。

【0089】

$$(7)$$

2, NdPt, Nd₃Pt₄, NdPt₂, NdPt₅, Bi₂Nd, BiNd, Bi₃Nd₄, Bi₃Nd₅, BiNd₂, Cd₂Nd, CdNd, Mn₂Nd, Mn₂₃Nd₆, Mn₁₂Nd, Nd₅Sb₃, Nd₄Sb₃, NdSb, NdSb₂, Fe₂Nd, Fe₁₇Nd₂, Cs₃Ge₂, CsGe, CsGe₄, Nd₅Si₃, Nd₅Si₄, NdSi, Nd₃Si₄, Nd₂Si₃, Nd₅Si₉, Cs₂Te, NdTe₃, Nd₂Te₅, NdTe₂, Nd₄Te₇, Nd₂Te₃, Nd₃Te₄, NdTe, Ce₃Ir, Ce₂Ir, Ce₅₅Ir₄₅, CeIr₂, CeIr₃, Ce₂Ir₇, CeIr₅, CaPd, CaPd₂, CaGe, Ca₂Ge, GeNa₃, GeNa, CaSi₂, Ca₂Si, CaSi, Se₂Sr, Se₃Sr₂, SeSr, GeSr₂, GeSr, Ge₂Sr, SnSr, Sn₃Sr₅, SnSr₂, Ce₂T₁, Ce₅T₁₃, CeT₁₃, Ce₃T₁₅, CeT₁, BaT₁, Pd₁₃T₁₉, Pd₂T₁, Pd₃T₁, Mg₂Si, Mg₂Ge, BaPd₂, BaPd₅, Ce₄Se₇, Ce₃Se₄, Ce₂Se₃, CeSe, Ce₅Ge₃, Ce₄Ge₃, Ce₅Ge₄, CeGe, Ce₃Ge₅, Ce₅Si₃, Ce₃Si₂, Ce₅Si₄, CeSi, Ce₃Si₅, CeSi₂, CeTe₃, Ce₂T₅, CeTe₂, Ce₄Te₇, Ce₃Te₄, CeT₁, La₃Se₇, LaSe₂, La₄Se₇, La₂Se₃, La₃Se₄, LaSe, GeLa₃, Ge₃La₅, Ge₃La₄, Ge₄La₅, GeLa, Ge₅La₃, BaSe₂, Ba₂Se₃, BaSe, PdSe, Mo₃Se₄, MoSe₂, Ba₂Ge, BaGe₂, BaGe, Ba₂Te₃, BaTe, Ge₂Pd₅, GePd₂, Ge₉Pd₂₅, GePd, Ge₃Pt, Ge₃Pt₂, GePt, Ge₂Pt₃, GePt₂, GePt₃, Pu₃Sn, Pu₅Sn₃, Pu₅Sn₄, Pu₈Sn₇, Pu₇Sn₈, Pu₈Sn₂, Pu₈Sn₃, Pt₅T₄, Pt₄T₅, PtTe₂, GeNi, Ge₃N₅, Ge₂Ni₅, GeNi₃, NiTe_{0.85}, NiTe_{0.775}, Ni₃T_{0.85}Te_{0.15}, Cr₁₁Ge₁₉, CrGe, Cr₁₁Ge₈, Cr₅Ge₃, Cr₃Ge, CrSi₂, Cr₅Si₃, Cr₃Si, Cr₅T₈, Cr₄Te₅

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5, Cr₃Te₄, Cr_{1-x}Te, Ge₃Mn₅, GeM_{n2}, Mn₆Si, Mn₈Si₂, Mn₃Si, Mn₅Si₂, Mn₅Si₃, MnSi, Mn₁₁Si₁₉, Mn₂Sn, Mn_{3.25}Sn, MnTe, Te₂W, FeGe₂, Fe₅Ge₃, Fe₃Ge, Fe₂Si, Fe₅Si₃, FeSi, FeSi₂, Ge₂Mo, Ge₄₁Mo₂₃, Ge₁₆Mo₉, Ge₂₃Mo₁₃, Ge₃Mo₅, GeMo₃, Mo₃Si, Mo₅Si₃, Mo₈Si₂, MoSn, Mo₈n₂, Mo₃Te₄, MoTe₂, Si₂Ti, SiTi, Si₄Ti₅, Si₃Ti₅, SiTi₃, Sn₅Ti₆, Sn₃Ti₅, SnTi₂, SnTi₃, CoGe₂, Co₅Ge₇, CoGe, Co₅Ge₃, Co₄Ge, Co₃T_{e4}, Ge₇Re₃, Re₅Si₃, ReSi, ReSi₂, Re₂Te。

【0097】(64) 高融点成分の平均組成は、また、前記A群及び下記のB群に挙げた化合物、のうち少なくとも一者、もしくはこれに近い組成あるいは、融点600℃以上の化合物とことができる。

【0098】<B群>Cs₃Ge, Ba₂Tl, GePd₃, Fe₆Ge₅, FeTe₂, Co₅Ge₂, Nd₃Pd, Cs₃Te₂, Ce₄Ir, NaPd, Ca₉Pd, Ca₃Pd₂, Ca₂Ge, Se₃Sr, Ce₃Tl, CeSe₂, Ce₃Ge, BaSe₃, GeSe₂, GeSe, BaTe₂, GePd₅, Ge₈Mn₁₁, MnTe₂, Ge₃W₂, FeGe, Fe₄Ge₃, Fe₃Sn, Fe₃Sn₂, FeSn, CoTe₂.

【0099】(65) 高融点成分の平均組成は、また、前記B群及び下記C群に挙げた化合物、のうち少なくとも一者、もしくはこれに近い組成、あるいは、融点400℃以上の化合物とができる。

【0100】<C群>Ba₄Tl, CsTe, Ba₄Tl, Ba₁₃Tl, Cd₁₁Nd, Cd₆Nd, Cs₅T_{e4}, Ca₃Pd, Ca₅Pd₂, Sn₃Sr, Ba₁₃Tl, PdT₁₂, FeSe₂, FeSe, Cr₂Te₃, CrTe₃, FeSn₂。

【0101】(66) 高融点成分として前記A群に挙げたものを使用するとき、相変化成分の平均組成は、下記D群の組成のうち少なくとも一者、もしくはこれに近い組成あるいは、融点650℃以下の化合物であることが好ましい。

【0102】<D群>Sn, Pb, Sb, Te, Zn, Cd, Se, In, Ga, S, Tl, Mg, Tl₂Se, TlSe, Tl₂Se₃, Tl₃Te₂, TlTe, InBi, In₂Bi, TeBi, Tl-Se, Tl-Te, Pb-Sn, Bi-Sn, Se-Te, S-Se, Bi-Ga, Sn-Zn, Ga-Sn, Ga-In, In₃SeTe₂, AgInTe₂, GeSb₄Te₇, Ge₂Sb₂Te₅, GeSb₂Te₄, GeBi₄T_{e7}, GeBi₂Te₄, Ge₃Bi₂Te₆, Sn₂Sb₆Se₁₁, Sn₂Sb₂Se₅, SnSb₂Te₄, Pb₂

Sb₆Te₁₁, CuAsSe₂, Cu₃AsSe₃, CuSb₂, CuSbSe₂, InSe, Sb₂Se₃, Sb₂Te₃, Bi₂Te₃, SnSb, FeTe, Fe₂Te₃, FeTe₂, ZnSb, Zn₃Sb₂, VT_{e2}, V₅Te₈, AgIn₂, BiSe, InSb, In₂Te, In₂T_{e5}, Ba₄Tl, Cd₁₁Nd, Ba₁₃Tl, Cd₆Nd, Ba₂Tl。

【0103】(67) 高融点成分として前記B群に挙げたものを使用するとき、相変化成分の平均組成は、下記E群の組成のうち少なくとも一者、もしくはこれに近い組成あるいは、融点450℃以下の化合物であることが好ましい。

【0104】<E群>Sn, Pb, Te, Zn, Cd, Se, In, Ga, S, Tl, Tl₂Se, TlSe, Tl₂Se₃, Tl₃Te₂, TlTe, InBi, In₂Bi, TeBi, Tl-Se, Tl-Te, Pb-Sn, Bi-Sn, Se-Te, S-Se, Bi-Ga, Sn-Zn, Ga-Sn, Ga-In, Ba₄Tl。

【0105】(68) 高融点成分として前記C群に挙げたものを使用するとき、相変化成分の平均組成は、下記F群の組成のうち少なくとも一者、もしくはこれに近い組成あるいは、融点250℃以下の化合物であることが好ましい。

【0106】<F群>Sn, Se, In, Ga, S, InBi, In₂Bi, TeBi, Tl-Se, Tl-Te, Pb-Sn, Bi-Sn, Se-Te, S-Se, Bi-Ga, Sn-Zn, Ga-Sn, Ga-In。

【0107】(69) 超解像読み出し用薄膜の組成または膜厚は、内周と外周において異なることが好ましく、超解像読み出し用薄膜のトラック周辺部も結晶化するのが好ましい。本発明による超解像読み出し用薄膜は、すでに情報が記録されたROMディスク及び情報を記録できるRAMディスクのいずれの情報記録媒体にも適用できる。

【0108】(70) 本発明による超解像読み出し用薄膜を備える情報記録媒体の超解像読み出し用装置は、超解像読み出し用薄膜の最高温度となる領域でも膜全体は融解しないで高融点成分が固相に留まる超解像読み出しパワーにプリセットがされているか、手動または自動で設定する手段を有することが好ましい。また、超解像読み出し時の反射光強度分布の乱れを検出する手段と、上記乱れの大きさに応じてレーザパワーを調節する手段を有することが好ましい。また、超解像読み出し時のレーザパワーをオートフォーカスやトランкиングに必要なパワーに比較して2倍以上大きくする手段を有することが好ましく、3倍以上大きくする手段を有することがより好ましい。この装置は、本発明以外の媒体に用いても、超解像読み出しレーザパワー一定の場合より良好な結果が得られる。

【0109】(71) 超解像読み出しレーザ光はパルス

光とし、レーザパルスの周期T、線速v、スポット径(λ/NA)、パルス幅xが下記(9)及び(10)の*

$$0.4\lambda/NA \leq vT \leq 1.5\lambda/NA \quad (9)$$

$$0.3 \leq x/T \leq 0.5 \quad (10)$$

さらに下記(12)及び(10)の関係を満たすことがより好ましい。

$$0.5\lambda/NA \leq vT \leq 0.9\lambda/NA \quad (12)$$

(72) 基板上に直接または保護層を介して形成された、エネルギービームの照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用薄膜において、当該薄膜を有する情報記録用媒体を用いる情報の記録再生装置または媒体初期結晶化用装置でレーザ光を繰り返し照射することにより、当該薄膜の残成分より相対的に融点が高い高融点成分が析出し、その析出物が当該薄膜の残成分からなる領域内に分布する特徴を持つ。

【0111】(73) 基板上に直接または保護層を介して形成された、エネルギービームの照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用薄膜を有する情報記録用媒体を用いる情報の記録再生方法または媒体初期結晶化用方法においてレーザ光を繰り返し照射することにより、当該薄膜の残成分より相対的に融点が高い高融点成分が析出し、その析出物が当該薄膜の残成分からなる領域内に分布する特徴を持つ。

【0112】(74) (1)から(6)に記載の情報記録用薄膜において、当該薄膜を有する情報記録用媒体を用いる情報の記録再生装置または媒体初期結晶化用装置においてレーザ光を繰り返し照射することにより、当該薄膜の残成分より相対的に融点が高い高融点成分が析出し、その析出物が当該薄膜の残成分からなる領域内に分布し、その析出物が前記BおよびXの少なくとも一方で表わされる元素を含むことを特徴とする。

【0113】(75) 基板上に直接または保護層を介して形成された、エネルギービームの照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用媒体の製造方法であって、基板上に保護層、記録膜または超解像読みだし膜、中間層、反射層を形成する工程と、これに別の基板または同様にして前記各層を形成した別の基板を貼り合わせる工程と前記媒体にエネルギービームを照射して前記薄膜中に高融点成分を生成または成長させる工程とを備えてなることを特徴とする。

【0114】(76) 基板上に直接または保護層を介して形成された、エネルギービームの照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用媒体の製造方法であって、基板上に保護層を形成する工程と高融点成分の材料あるいは高融点成分の組成に近い組成を持つ材料を被着させて島状の種結晶を形成する工程と、前記種結晶の上に前記高融点成分と前記残成分とを含む材料を被着させ、前記高融点成分を選択的に前記種結晶上に成長させると共に、それら種結晶の間を埋めるように前記残成分を成長させる工程と中間層、反射層

*関係を満たすことが好ましく、

$$(9)$$

$$(10)$$

※【0110】

※

$$0.5\lambda/NA \leq vT \leq 0.9\lambda/NA \quad (12)$$

を形成する工程と、これに別の基板または同様にして前記各層を形成した別の基板を貼り合わせる工程と備えてなることを特徴とする。

【0115】(77) 基板上に直接または保護層を介して形成された、エネルギービームの照射を受けて生じる原子配列変化によって情報を記録または再生する情報記録用媒体の製造方法であって、基板上に保護層を形成する工程と、相変化成分と高融点成分より成る膜の形成を行ないつつ高融点成分の含有量を膜厚方向に変化させる工程と、中間層、反射層を形成する工程と、これに別の基板または同様にして前記各層を形成した別の基板を貼り合わせる工程を備えてることを特徴とする。

【0116】(78) 前記高融点成分としては、例えば、LaTe₃, LaTe₂, La₂Te₃, La₃Te₄, LaTe, La₂Te₅, La₄Te₇, La₃Te, La₂Sb, La₃Sb₂, LaSb, LaSb₂, La₃Ge, La₅Ge₃, La₄Ge₃, La₅Ge₄, LaGe, La₃Ge₅, Ag₂Te, Cr₃Te₄, Cr₅Te₈, Cr₂Te₃, Cr₄Te₅, CrSb, Cr₃Ge, Cr₅Ge₃, Cr₁₁Ge₈, CrGe, Cr₁₁Ge₁₉, PtTe₂, Pt₄Te₅, Pt₅Te₄, Pt₄Sb, Pt₃Sb₂, PtSb, Pt₃Ge, Pt₂Ge, Pt₃Ge₂, PtGe, Pt₂Ge₃, PtGe₃, NiTe, NiTe_{0.85}, NiSb, Ni₃Ge, Ni₅Ge₂, Ni₅Ge₃, NiGe, CoTe, CoTe₂, Co₃Te₄, CoSb, CoSb₂, CoSb₃, Co₅Ge₂, Co₅Ge₃, CoGe, Co₅Ge₇, CoGe₂, Si₂Te₃, SiSb, SiGe, CeTe, Ce₃Te₄, Ce₂Te₃, Ce₄Te₇, CeTe₂, CeTe₃, Ce₂Sb, Ce₅Sb₃, Ce₄Sb₅, CeSb, CeSb₂, Ce₃Ge, Ce₅Ge₃, Ce₄Ge₃, Ce₅Ge₄, CeGe, Ce₃Ge₅, Ce₅Si₃, Ce₃Si₂, Ce₅Si₄, CeSi, Ce₃Si₅, CeSi₂, Cr₃Si, Cr₅Si₃, CrSi, CrSi₃, CrSi₂, Co₃Si, CoSi, CoSi₂, NiSi₂, NiSi, Ni₃Si₂, Ni₂Si, Ni₅Si₂, Ni₃Si, Pt₅Si₂, Pt₂Si, PtSi, LaS₂, Ag₃In, Ag₂In, Bi₂Ce, BiCe, Bi₃Ce₄, Bi₃Ce₅, BiCe₂, Cd₁₁Ce, Cd₆Ce, Cd₅₈Ce₁₃, Cd₃Ce, Cd₂Ce, CdCe, Ce₃In, Ce₂In, Ce_{1+x}In, Ce₃In₅, CeIn₂, CeIn₃, Ce₂Pb, CePb, CePb₃, Ce₃Sn, Ce₅Sn₃, Ce₅Sn₄, Ce₁₁Sn₁₀, Ce₃Sn₅, Ce₃Sn₆

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7, Ce₂Sn₅, CeSn₃, CeZn, CeZn₂, CeZn₃, Ce₃Zn₁₁, Ce₁₃Zn₅₈, CeZn₅, Ce₃Zn₂₂, Ce₂Zn₁₇, CeZn₁₁, Cd₂₁Co₅, CoGa, CoGa₃, CoSn, Cr₃Ga, CrGa, Cr₅Ga₆, CrGa₄, Cu₉Ga₄, Cu₃Sn, Cu₃Zn, Bi₂La, BiLa, Bi₃La₄, Bi₃La₅, BiLa₂, Cd₁₁La, Cd₁₇La₂, Cd₉La₂, Cd₂La, CdLa, Ga₆La, Ga₂La, GaLa, Ga₃La₅, GaLa₃, In₃La, In₂La, In₅La₃, In_xLa, InLa, InLa₂, InLa₃, La₅Pb₃, La₄Pb₃, La₁₁Pb₁₀, La₃Pb₄, La₅Pb₄, LaPb₂, LaPb₃, LaZn, LaZn₂, LaZn₄, LaZn₅, La₃Zn₂₂, La₂Zn₁₇, LaZn₁₁, LaZn₁₃, NiBi, Ga₃Ni₂, GaNi, Ga₂Ni₃, Ga₃Ni₅, GaN₃, Ni₃Sn, Ni₃Sn₂, Ni₃Sn₄, NiZn, Ni₅Zn₂₁, PtBi, PtBi₂, PtBi₃, PtCd₂, Pt₂Cd₉, Ga₇Pt₃, Ga₂Pt, Ga₃Pt₂, GaPt, Ga₃Pt₅, GaPt₂, GaPt₃, In₇Pt₃, In₂Pt, In₃Pt₂, InPt, In₅Pt₆, In₂Pt₃, InPt₂, InPt₃, Pt₃Pb, PtPb, Pt₂Pb₃, Pt₃Sn, PtSn, Pt₂Sn₃, PtSn₂, PtSn₄, Pt₃Zn, PtZn₂, AlS, Al₂S₃, BaS, BaC₂, CdS, Co₄S₃, Co₉S₈, CoS, CoO, Co₃O₄, Co₂O₃, Cr₂O₃, Cr₃O₄, CrO, CrS, CrN, Cr₂N, Cr₂₃C₆, Cr₇C₃, Cr₃C₂, Cu₂S, Cu₉S₅, CuO, Cu₂O, In₄S₅, In₃S₄, La₂S₃, La₂O₃, Mo₂C, MoC, Mn₂₃C₆, Mn₄C, Mn₇C₃, NiO, Si₂S₂, SiO₂, Si₃N₄, Cu₂Te, CuTe, Cu₃Sb, Mn₂Sb, MnTe, MnTe₂, Mn₅Ge₃, Mn_{3.25}Ge, Mn₅Ge₂, Mn₃Ge₂, Ge₃W, Te₂W, AlSb, Al₂Te₃, Fe₂Ge, FeGe₂, Fe₃SB₂, Mo₃Sb₇, Mo₃Te₄, MoTe₂, PbTe, GePd₂, Ge₂Pd₅, Ge₉Pd₂₅, GePd₅, Pd₃Sb, Pd₅Sb₃, PdSb, SnTe, Ti₅Ge₃, Ge₃V₁₇, Ge₈V₁₁, Ge₃V₅, GeV₃, V₅Te₄, V₃Te₄, ZnTe, Ag₂Se, Cu₂Se, Al₂Se₃, InAs, CoSe, Mn₃In, Ni₃In, NiIn, Ni₂In₃, Ni₃In₇, PbSe, などの高融点化合物、あるいはこれらに近い組成の高融点化合物、あるいはこれらの混合物、あるいはこれらの混合組成に近い3元以上の化合物がある。

【0117】これらの中では、LaSb, CrSb, CoSb, Cr₃Te₄, Cr₂Te₃, Cr₄Te₅, CoTe, Co₃Te₄, LaTe₃, Cu₂Te, CuTe, Cu₃Sb, MnTe, MnTe₂, Mn₂Sbのうちの少なくとも1つが特に好ましい。その理由は、屈折率が残成分に近いので、ノイズが発生しにくく融点も高いこと

にある。

【0118】前記高融点成分中に含まれる酸化物、硫化物、窒化物、炭化物の含有量は、前記高融点成分の全構成原子数の40原子%未満とするのが好ましく、10原子%未満とするのが特に好ましい。これらの含有量が40原子%以上であると、当該薄膜の高融点成分以外の成分すなわち残成分との複素屈折率の差を小さくできなかったり、当該残成分中に酸素等が拡散して記録・再生特性を劣化させたりする問題を生じやすいからである。

10 【0119】前記情報記録用薄膜では、前記高融点成分の析出物が分布した状態で情報の記録・再生・消去を行なうものであるから、前記高融点成分と、可逆的に相変化する成分との混合組成になっているのが好ましい。ここで「相変化」とは、結晶状態-非晶質状態間の相変化だけでなく、結晶状態-結晶質状態間の相変化も含む。

【0120】可逆的に相変化する成分としては、既知の相変化記録材料の他、好適な相変化特性を持った材料であれば任意のものを使用することができるが、高融点成分の例として前で述べた多数の化合物の中では、Crなどの遷移金属元素を含む化合物が好ましく、且つその遷移金属元素の含有量は当該薄膜の総構成原子数の40原子%以下が好ましく、34原子%以下がより好ましい。この条件が満たされると、析出する高融点成分とTe系またはSb系の相変化成分との界面反射率を小さくする効果が大きくなるという利点がある。

20 【0121】前記高融点成分の屈折率の実数部n₁と虚数部k₁の値は、前記高融点成分と相変化成分との界面での光散乱を防ぐ観点から、前記相変化成分の結晶状態での実数部n₂と虚数部k₂の値のそれぞれ±4.0%以内であるのが好ましく、±2.0%以内であるのがより好ましい。

30 【0122】n₁とn₂の差が±1.0%以内、k₁とk₂の差が±7.0%以内であり、且つ $[(n_1 + ik_1) - (n_2 + ik_2)] / [(n_1 + ik_1) + (n_2 + ik_2)]$ の^{1/2}で表わされる界面反射率が6%以下があるのが好ましい。また、n₁とn₂の差が±1.0%以内、k₁とk₂の差が±7.0%以内であり、且つ界面反射率が2%以下であるのがより好ましい。これらの条件を満たすことは、膜厚を厚くして再生信号レベルを大きくし、界面での光散乱を防ぐのに好ましい。

40 【0123】高融点成分の屈折率(n, k)の好ましい範囲は、相変化成分がGe-Sb-Te系の場合は、 $5.0 \leq n \leq 6.2$, $1.1 \leq k \leq 6.1$ であり、相変化成分がIn-Sb-Te系の場合は、

1.5 $\leq n \leq 1.8$, $0.6 \leq k \leq 3.6$ である。

【0124】高融点成分が前記情報記録用薄膜において、高融点成分の析出物を明確に判別できない場合は、次のように解する。すなわち、当該薄膜の平均組成から前記高融点成分以外の残成分(例えば相変化成分)の組成のいずれか一つを除くと、残部の80%以上、より好

ましくは90%以上がこの発明の融点の条件を満たす高融点成分の組成となる場合、この発明の高融点成分が析出しているものとする。

【0125】情報記録用薄膜の保護に用いる「保護層」は、有機物でもよいし無機物でもよいが、無機物の方が耐熱性の面で好ましい。しかし、機械的強度を増すために、基板とは別に形成した無機物の保護層を厚くすると、クラック発生、透過率低下、感度低下などを生じやすいので、この保護層を薄くする一方、この保護層の当該情報記録用薄膜と反対の側に厚い有機物層を密着させるのが好ましい。この有機物層は基板とは別に形成した層でもよいし、有機物の基板でもよい。これによって変形が起り難くなる。

【0126】有機物の保護層は、例えばアクリル樹脂、ポリカーボネート、ポリオレフィン、エポキシ樹脂、ポリイミド、ポリアミド、ポリスチレン、ポリエチレン、ポリエチレンテレフタレート、ポリ4フッ化エチレン（テフロン）などのフッ素樹脂などにより形成することができる。ホットメルト接着剤として知られているエチレン-酢酸ビニル共重合体などや、粘着剤などでもよい。これらの樹脂の少なくとも1つを主成分とする紫外線硬化樹脂で形成してもよい。有機物の基板で保護層を兼ねてもよい。

【0127】無機物の保護層は、例えば酸化物、弗化物、窒化物、硫化物、セレン化物、炭化物、ホウ化物、ホウ素、炭素、あるいは金属などを主成分とする無機物などにより形成することができる。ガラス、石英、サファイア、鉄、チタン、あるいはアルミニウムを主成分とする無機物の基板で保護層を兼ねてもよい。

【0128】無機物の保護層の例としては、Ce, La, Si, In, Al, Ge, Pb, Sn, Bi, Te, Ta, Sc, Y, Ti, Zr, V, Nb, CrおよびWよりなる群より選ばれた少なくとも1つの元素の酸化物、Cd, Zn, Ga, In, Sb, Ge, Sn, Pbよりなる群より選ばれた少なくとも1つの元素の硫化物またはセレン化物、Mg, Ce, Caなどの弗化物、Si, Al, Ta, Bなどの窒化物、または、ホウ素あるいは炭素より成るものであって、たとえば主成分が、CeO₂, La₂O₃, SiO, SiO₂, In₂O₃, Al₂O₃, GeO, GeO₂, PbO, SnO, SnO₂, Bi₂O₃, TeO₂, WO₂, WO₃, Ta₂O₅, Sc₂O₃, Y₂O₃, TiO₂, ZrO₂, CdS, ZnS, CdSe, ZnSe, In₂S₃, In₂Se₃, Sb₂S₃, Sb₂Se₃, Ga₂S₃, Ga₂Se₃, MgF₂, CeF₃, CaF₂, GeS, GeSe, GeSe₂, SnS, SnS₂, SnSe, SnSe₂, PbS, PbSe, Bi₂Se₃, Bi₂S₃, TaN, Si₃N₄, AlN, Al₂SiN₂, Si, TiB₂, B₄C, SiC, B, Cのうちの1つあるいはそれに近い組成をもつたもの、またはそれらの混合物がある。

【0129】これらのうち、硫化物では、ZnSまたはそれに近い組成のものが、屈折率が適当な大きさで膜が安定である点で好ましい。窒化物では、表面反射率があまり高くなく、膜が安定で強固である点で、TaN, Si₃N₄, Al₂SiN₂またはAlN（窒化アルミニウム）またはそれに近い組成のものが好ましい。酸化物では、膜が安定である点で、Y₂O₃, Sc₂O₃, CeO₂, TiO₂, ZrO₂, SiO, Ta₂O₅, In₂O₃, Al₂O₃, SnO₂またはSiO₂またはそれらに近い組成のものが好ましい。水素を含む非晶質Siでもよい。

【0130】前記保護層を無機物-無機物、あるいは無機物-有機物の2層あるいは3層以上の多層構成にすれば、さらに保護効果が高まる。

【0131】前記保護層に混合物を使用すると、膜形成が容易である。例えば、厚さ50~500nmの(ZnS)₈₀(SiO₂)₂₀層では、保護効果、記録・消去特性、書き換え特性ともに良好であり、膜の形成も容易である。

【0132】前記保護層はまた、有機物および無機物の複合材料により形成することもできる。

【0133】無機物の保護層は、そのままの組成で電子ビーム蒸着、スパッタリングなどにより形成してもよいが、反応性スパッタリングあるいは、金属、半金属、半導体の少なくとも1元素よりなる膜を形成した後に酸素、硫黄、窒素のうちの少なくとも一つと反応させると、成膜が容易となる。

【0134】一般に、薄膜に光を照射すると、薄膜の表面からの反射光と薄膜の裏面からの反射光との重ね合わせにより干渉が生じる。そこで、薄膜の反射率の変化で信号を読み取る場合には、記録用薄膜に近接して光を反射する「反射層」を設けることにより、干渉の効果を大きくし、それによって再生（読み出し）信号を大きくすることができる。なお、光を吸収する吸収層としてもよい。

【0135】干渉の効果をより大きくするためには、記録用薄膜と反射層の間に「中間層」を設けるのが好ましい。中間層は、書き換え時に記録用薄膜と反射層との間で相互拡散が起こるのを防止する作用、および反射層への熱の逃げを減少させて記録感度を高め、消え残りを防止する作用がある。

【0136】中間層の材質を適当に選ぶと、情報記録用薄膜の役割の少なくとも一部を担わせることもできる。例えば、中間層をセレン化物で形成すると、記録用薄膜の少なくとも一部の元素が中間層中へ拡散し、あるいは中間層中の元素と反応し、あるいは中間層の少なくとも一部の元素が記録用薄膜または反射層中へ拡散し、それによって記録用薄膜の一部の役割を果たすようになる。

【0137】中間層の膜厚は、3nm以上、400nm以下で、且つ、記録状態および消去状態のいずれか一方

において、読み出し光の波長付近で記録用薄膜の反射率が極小値に近く、しかもその値が他方の状態において20%付近あるいはそれ以上となるようにするのが好ましい。

【0138】反射層として、熱伝導率が $2.0 \text{ W/cm} \cdot \text{deg}$ 以上の高熱伝導率材料（例えば Au など）を主成分とする材料を用いると、熱拡散率が高くなり、高速で結晶化する記録用薄膜を用いても、高パワーのレーザ光を照射したときに確実に非晶質化するようになる。この場合、中間層にも、熱伝導率の高い材料（例えば Al_2O_3 , AlN , Si_3N_4 , ZnS などあるいはそれに近い組成の材料）を用いるか、 SiO_2 などの熱伝導率が中程度 ($0.02 \text{ W/cm} \cdot \text{deg}$ 以上, $0.1 \text{ W/cm} \cdot \text{deg}$ 以下) の材料を用い、中間層を薄くするのが特に好ましい。ただし、記録感度を高めるには、前記の値よりも低い熱伝導率の材料で反射層を形成するのが好ましい。

【0139】反射層は、情報記録用薄膜の基板側に配置してもよいし、情報記録用薄膜の基板とは反対側に配置してもよい。

【0140】反射層の中間層とは反対の側に、前記保護層に使用可能な無機物よりなる保護層（上びき層）を形成すれば、さらに好ましい。これら中間層、反射層、保護層よりなる3層構成では、全体として、単層の保護層より強固となる。

【0141】前記基板、記録用薄膜、保護層、中間層および反射層の形成は、真空蒸着、ガス中蒸着、スパッタリング、イオンビーム蒸着、イオンプレーティング、電子ビーム蒸着、射出成形、キャスティング、回転塗布、プラズマ重合などの方法からいずれかを適宜選定して行なえばよい。

【0142】前記記録用薄膜、保護層、中間層、反射層、および反射層に隣接した保護層は、すべてスパッタリングにより形成するのが最も好ましい。

【0143】前記の情報記録用薄膜は、共蒸着や共スパッタリングなどによって、保護膜用に使用可能な材料として前述した酸化物、弗化物、窒化物、有機物など、あるいは炭素または炭化物の中に分散させた形態としてもよい。そうすることによって、光吸収係数を調節し再生信号強度を大きくすることができる場合がある。

【0144】この場合、混合比率は、薄膜中で酸素、弗素、窒素、炭素が膜全体に対して占める原子数の割合が40%以下が好ましく、20%以下がより好ましい。

【0145】このような複合膜化を行なうことにより、結晶化の速度が低下し、感度が低下するのが普通であるが、有機物との複合膜化では感度が向上する。

【0146】一般に、相転移（相変化）によって情報の記録を行なう場合、記録膜の全面をあらかじめ結晶化させておくのが好ましいが、基板に有機物を用いている場合には基板を高温にすることができない。そこで、それ

以外の方法で結晶化させる必要がある。

【0147】この場合の好ましい結晶化法としては、例えば、スポット径が $2 \mu\text{m}$ 以下となるように集束したレーザ光の照射、キセノンランプや水銀ランプなどによる紫外線照射と加熱、フラッシュランプ光の照射、高出力ガスレーザや出力 1W 程度の高出力半導体レーザからの大きなレーザ光スポットによる光の照射、あるいは加熱とレーザ光照射との組合せなどがある。

【0148】スポット径を $2 \mu\text{m}$ 以下まで集束したレーザ光を情報記録用薄膜に照射する場合、複数回の照射が必要となる場合が多い。このため、単一のレーザ光では、薄膜に繰り返し照射することになり、長時間を要する。これを避けるには、半導体レーザアレイを用いるか、ガスレーザのビームを複数に分割して同時に複数箇所に照射するようにするのがよい。これにより、薄膜を1回転するだけで多数回のレーザ光照射が可能となる。

【0149】各光スポットは、同一の記録トラック上に並列させてもよいが、2つあるいはそれ以上のトラック上に並列させてもよい。トラック上とトラック間に同時に照射するようにすれば、さらに好ましい。各スポットのレーザ光パワーは同じである必要はない。

【0150】ガスレーザあるいは高出力半導体レーザからの単一ビームを照射する場合、スポット径（円形の光スポットであれば光強度が $(1/2)$ になる位置での直径、楕円形の光スポットであれば前記位置での長径）が $5 \mu\text{m}$ 以上、 5mm 以下とすると能率がよい。

【0151】結晶化を記録トラック上のみで生じさせ、トラック間は非晶質のままとしてもよい。記録トラック間のみを結晶化させてもよい。

【0152】例えば、 Sb , Te , Ge および Cr を主成分とする薄膜を複数の蒸発源からの回転蒸着によって形成した場合、蒸着直後には Sb , Te , Ge および Cr の原子がうまく結合していない場合が多い。また、この薄膜をスパッタリングによって形成した場合も、原子配列が極めて乱れた状態になる。そこで、このような場合には、まず、高いパワー密度のレーザ光を記録トラック上に照射して加熱し、高融点成分を析出させるとともに、場合によっては薄膜を選択的に融解させるのがよい。その後、前記記録トラック上に低いパワー密度のレーザ光を照射して前記薄膜を結晶化させる。こうすると、トラック全周にわたって反射率が均一になりやすい利点がある。

【0153】レーザ光などのエネルギービームを照射する前には、情報記録用薄膜中に高融点成分が存在しない場合もあるが、以上のような結晶化処理により、その薄膜中に高融点成分を析出あるいは成長させることができる。析出あるいは成長した高融点成分は、前述したように、薄膜中にはほぼ独立して粒状または柱状に分布し、あるいは、高融点成分が連続して多孔質状に分布する。前者の場合は、当該薄膜の残成分（通常は相変化成分）の

中に高融点成分が分布する。後者の場合は、高融点成分の析出物の多数の孔の中に残成分が埋め込まれる。

【0154】この第1の製造方法では、高融点成分は情報記録用薄膜の両側の界面からその内部に向かって成長しやすい。

【0155】結晶化するパワー・レベルと非晶質に近い状態にするパワー・レベルとの間でパワー・変調したレーザ光で情報を記録（オーバーライト）することは、薄膜の結晶化後の状態の如何に関わらず可能である。

【0156】この発明の第1～第6の情報記録用薄膜では、必ずしも非晶質状態と結晶状態の間の変化を記録に利用する必要はなく、膜の形状変化をほとんど伴わない何らかの原子配列変化によって、光学的性質の変化を起こさせれば足りる。前記高融点成分の析出物により、薄膜の流動・偏析が確実に防止される。

【0157】例えば、結晶粒径や結晶形の変化、結晶と準安定状態（ α 、 γ など）との間の変化などでもよい。非晶質状態と結晶状態の変化でもよいし、完全な非晶質や結晶状態でなく両状態の部分が混在し、それらの比率が変化するだけでもよい。

【0158】また、記録用薄膜と、保護層および中間層のうちの少なくとも一つとの間で、これらの層を構成する原子のうちの一部が拡散、化学反応などにより移動することにより、情報が記録されるものでもよいし、原子の移動と相変化の両方により情報が記録されるものでもよい。

【0159】この発明の第1の情報記録媒体は、前記第1～第6のいずれかの情報記録用薄膜を記録層として備えていることを特徴とする。

【0160】前記情報記録用薄膜の少なくとも一方の界面は、前記保護層に密着しているのが好ましい。保護層により、情報書き換え時の薄膜の変形に起因するノイズ増加を防止することができる。

【0161】この発明の第2の情報記録媒体は、前記第1および第6の情報記録用薄膜のいずれかを、超解像読み出し用のマスク層として備えていることを特徴とする。

【0162】

【作用】この発明の第1～第4の情報記録用薄膜およびそれを用いた情報記録媒体では、SbおよびTeに前記BまたはXに表される元素が添加されているので、レーザ光などの記録・再生光の照射によって融解しない高融点成分の析出物が内部に生成される。このため、高融点成分以外の残成分が前記光によって融解しても、その流動および偏析が効果的に防止され、その結果、多数回書き換えした際の流動および偏析が効果的に防止される。また、析出した高融点成分が情報記録用薄膜の膜厚の厚さまで大きい場合は上記薄膜が接している保護層や中間層の熱膨張による変形を押さえ、保護層と中間層の間隔を保つため、上記薄膜の流動防止効果がより高くなる。このため、搬送波対雜音比（C/N）が安定し、記録・

再生特性を良好に保ちながら従来より多数回の書き換えあるいは読み出しが可能となる。

【0163】Sb、Teおよび前記BまたはXで表わされる元素にさらに前記Aで表わされる元素が共存すると、非晶質状態が安定に保持され、しかも記録・消去時の結晶化が高速で行なわれるようになる。また、結晶化速度が最適に制御され、搬送波対雜音比と消去比とが向上する。

【0164】この発明の第5および第6の情報記録用薄膜およびそれを用いた情報記録媒体では、レーザ光などの記録・再生光が照射されても、内部に含まれている高融点成分の析出物は融解しない。このため、高融点成分以外の残成分が前記光によって融解しても、その流動および偏析が効果的に防止される。その結果、記録・再生特性を良好に保ちながら従来より多数回の書き換えあるいは読み出しが可能となる。

【0165】この発明の第1の情報記録媒体では、前記第1～第6の情報記録用薄膜を備えているので、記録・再生特性を良好に保ちながら従来より多数回の書き換えあるいは読み出しが可能となる。

【0166】この発明の第2の情報記録媒体では、前記第1～第6の情報記録用薄膜のいずれかよりなるマスク層に光スポットが照射されると、光スポット内の高温部では、前記高融点成分以外の残成分が少なくとも融解する。高温部の屈折率の実数部または虚数部（消衰係数）は、光スポット外の低温部のそれよりも小さくなるため、前記マスク層により、光スポット径の領域の一部が部分的にマスクされ、あたかも光スポット径が減少したようになる。その結果、光スポット径よりも小さい記録マークを読み出すことができる、すなわち超解像読み出しが可能となる。

【0167】この発明の第3の情報記録媒体では、前記第1～第6の情報記録用薄膜のいずれかよりなる反射層に光スポットが照射されると、光スポットの径内の高温部の屈折率の実数部または消衰係数が光スポット外の低温部のそれよりも小さくなる。このため、当該反射層の高温部に照射された光の反射光には、記録マークの読み取りに十分なコントラストが与えられなくなる。その結果、あたかも光スポット径が減少したようになるため、光スポット径より小さいピッチで形成された記録マークを読み出すことができる、すなわち超解像読み出しが可能となる。

【0168】また、相変化成分より相対的に融点が高い高融点成分が析出しているため、超解像読み出し時に、レーザ照射によって超解像読み出し膜が融解した際の流動及び偏析が効果的に防止される。このため、良好な超解像読み出し特性を保ちながら従来より多数回の超解像読み出しが可能となる。

【0169】超解像読み出し用薄膜の平均組成を前記一般式（8）で表されるものとするとき、式中のAで表さ

れる元素は低温で融解するため、超解像読み出しが低温で可能となり、相変化光ディスクをはじめとする位相ピットで情報を記録した光ディスク以外の光ディスクでも超解像読み出しを行うことができる。これに前記Bで表される元素が共存すると、前記DとEの化合物またはEの元素またはEの元素同士の化合物が高融点成分となり、超解像読み出し膜が融解した際の流動及び偏析を防止する効果をもつ。(12)式中のFとして例えばT₁を共存させると、C/Nを大きくさせることができる。

【0170】本発明の超解像読み出し用装置では、超解像読み出し時にのみレーザパワーを大きくするため、超解像読み出し膜の劣化を防ぎ、多数回の超解像読み出しが可能となる。また、超解像読み出し時のレーザの周期T、線速v、スポット径(λ/NA)、パルス幅xが前記(9)及び(10)の関係を満たすことにより、超解像読み出し時のマスク領域の大きさを適当に保ち、超解像読み出し特性をよくすることができる。この装置は、本発明以外の媒体に用いても、超解像読み出しレーザパワー一定の場合より良好な結果が得られる。

【0171】

【実施例】以下、この発明を実施例によって詳細に説明する。

【0172】【実施例1】

(構成・製法) 図3は、この発明の第1実施例の情報記録用薄膜を用いたディスク状情報記録媒体の断面構造を示す。この媒体は次のようにして製作された。

【0173】まず、直径13cm、厚さ1.2mmで表面に断面U字形のトラッキング溝を有するポリカーボネート基板1を形成した。次に、この基板1上に薄膜を順次、形成するため、基板1をマグネットロン・スパッタリング装置内に置いた。この装置は複数のターゲットを持ち、積層膜を順次、形成することができるものである。また、形成される膜の厚さの均一性および再現性に優れている。

【0174】マグネットロン・スパッタリング装置により、基板1上にまず(ZnS)₈₀(SiO₂)₂₀膜よりなる保護層2を膜厚約125nmとなるように形成した。続いて、保護層2上に、高融点成分であるCr₄T₅膜(図示せず)を島状に平均膜厚3nmまで形成した後、その上にSb₁₆T₅₅Ge₁₆Cr₁₃、すなわち(Ge₂Sb₂T₅)₇(Cr₄T₅)₃の組成の記録膜3を膜厚約30nmまで形成した。この際、Cr₄T₅ターゲットとGe₂Sb₂T₅ターゲットとによる回転同時スパッタ法を用いた。島状Cr₄T₅膜のサイズは2~20nm程度、島のピッチは(サイズ)×(1.5~10)が望ましい。

【0175】Cr₄T₅膜は必ずしも形成する必要はない。その場合、記録膜3中に析出する高融点成分は、後述する初期結晶化の際に生じるもののみとなる。

【0176】次に、記録膜3上に、(ZnS)₈₀(Si

O₂)₂₀膜よりなる中間層4を約25nmの膜厚まで形成した後、その上に同じスパッタリング装置内でAl₁₉₇Ti₃膜よりなる反射層5を膜厚80nmまで形成した。こうして、第1のディスク部材を得た。

【0177】他方、まったく同様の方法により、第1のディスク部材と同じ構成を持つ第2のディスク部材を得た。第2のディスク部材は、直径13cm、厚さ1.2mmの基板1'上に順に積層された、膜厚約125nmの(ZnS)₈₀(SiO₂)₂₀膜よりなる保護層2'、平均膜厚3nmのCr₄T₅膜(図示せず)、膜厚約30nmのSb₁₆T₅₅Ge₁₆Cr₁₃、すなわち(Ge₂Sb₂T₅)₇(Cr₄T₅)₃の記録膜3'、膜厚約25nmの(ZnS)₈₀(SiO₂)₂₀膜よりなる中間層4'、および膜厚80nmのAl₁₉₇Ti₃膜よりなる反射層5'を備えている。

【0178】その後、塩化ビニル-酢酸ビニル系ホットメルト接着剤層6を介して、前記第1および第2のディスク部材の反射層5, 5'同士を貼り合わせ、図3に示すディスク状情報記録媒体を得た。

【0179】この媒体では、反射層5, 5'の全面を接着すると、全面を接着しない場合に比べて書き換え可能回数を多くすることができ、また、反射層5, 5'の記録領域に対応する箇所に接着剤を付けない場合、その箇所にも接着剤を付けた場合よりも少し記録感度が高くなつた。

【0180】(初期結晶化) 前記のようにして製作した媒体の記録膜3, 3'に、次のようにして初期結晶化を行なつた。なお、記録膜3'についてもまったく同様であるから、以下の説明では記録膜3についてのみ述べることとする。

【0181】媒体を1800rpmで回転させ、半導体レーザ(波長830nm)のレーザ光パワーを記録が行なわれないレベル(約1mW)に保ち、そのレーザ光を記録ヘッド中の開口数(NA)が0.55のレンズで集光し、基板1を通して記録膜3に照射した。記録膜3からの反射光を検出して、基板1のトラッキング溝の中心にレーザ光スポットの中心が常に一致するようにトラッキングを行なうと共に、記録膜3上にレーザ光の焦点が来るように、自動焦点合わせを行なながら記録ヘッドを駆動した。

【0182】まず、初期結晶化のため、記録膜5の同一記録トラック上に、パワー1.2mW, 1.3mW, 1.4mWの連続レーザ光をそれぞれ500回照射した。最後に、パワー1.5mWの連続(DC)レーザ光を1000回照射した。各回の照射時間(光スポット通過時間)は、約0.1μsecである。

【0183】続いて、パワー8mWの連続レーザ光を500回照射した。各回の照射時間(光スポット通過時間)は、約0.1μsecである。この時のレーザ光パワーは5~9mWの範囲であればよい。

【0184】前記2種類のレーザ光照射のうち、パワーの低い方(8mW)の照射は省略してもよい。

【0185】このように、パワーの異なるレーザ光を照射すると、初期結晶化を充分に行なうことができる。

【0186】これらのレーザ光照射は、半導体レーザ・アレイを用いて行なうか、ガスレーザからの光ビームを複数に分割したもの、あるいは高出力ガスレーザや半導体レーザからの光ビームのスポット形状を媒体の半径方向に長い長円形にしたもの用いて行なえば、さらに好ましい。こうすると、媒体を少数回転させるだけで初期結晶化を完了することも可能となる。

【0187】複数のレーザ光スポットを用いる場合、それらレーザ光スポットを同一の記録トラック上に配置せず、媒体の半径方向に位置を少しづつズラして配置すれば、1回の照射で広い範囲を初期化することができる、消え残りが少なくなる、などの効果が得られる。

【0188】次に、円形スポットの12mWの連続レーザ光(記録の高パワー光)を1回照射する(照射時間:約0.1μsec)毎に、パワー18mWのパルス・レーザ光(記録用の高パワー光)を照射し、記録膜5を非晶質化して記録点を形成した。その後、その記録点を8mWの連続レーザ光(初期結晶化用の低パワー光)を照射して結晶化させるために、8mWの連続レーザ光を何回照射が必要かを調査した。

【0189】その結果、12mWの連続レーザ光の照射回数が5回までは、照射回数が増加するほど、結晶化に要する前記8mWの連続レーザ光照射の回数は低下した。すなわち、照射回数が増加するほど結晶化しやすいことが分かった。これは、12mWの連続レーザ光の照射により、記録膜5中に高融点成分であるCr₄T₅の微細な結晶が多数析出し、その残部(相変化する部分)の組成が高速結晶化可能なGe₂S₂T₅の組成に近づいたためと推察される。

【0190】なお、Cr₄T₅の融点は1252°Cであり、Ge₂S₂T₅の融点は630°Cである。

【0191】(記録・消去) 次に、以上のようにして初期結晶化が完了した記録膜3の記録領域に、前記と同様にしてトラッキングと自動焦点合わせを行ないながら、記録用レーザ光のパワーを記録すべき情報信号に従って中間パワーレベル(8mW)と高パワーレベル(18mW)との間で変化させて情報の記録を行なった。記録すべき部分を通り過ぎると、レーザ光パワーを再生(読み出し)用レーザ光の低パワーレベル(1mW)に下げるようとした。記録用レーザ光により記録領域に形成される非晶質またはそれに近い部分が、記録点となる。

【0192】記録用レーザ光の高レベルと中間レベルとのパワー比は1:0.3~1:0.8の範囲が特に好ましい。また、この他に、短時間ずつ他のパワーレベルにしてもよい。

【0193】このような記録方法では、既に情報が記録

されている部分に対して直接、新たな情報を記録すれば、新たな情報に書き換えられる。すなわち、単一の円形光スポットによるオーバーライトが可能である。

【0194】しかし、書き換え時の最初の1回転または複数回転で、前記のパワー変調した記録用レーザ光の中間パワーレベル(8mW)に近いパワー(例えは9mW)の連続光を照射して、記録されている情報をいったん消去し、その後、次の1回転で再生(読み出し)用レーザ光の低パワーレベル(1mW)と記録用レーザ光の高パワーレベル(18mW)の間で、または、記録用レーザ光の中間パワーレベル(8mW)と高パワーレベル(18mW)の間で、情報信号に従ってパワー変調したレーザ光を照射して記録するようにしてもよい。このように、情報を消去してから記録するようにすれば、前に書かれていた情報の消え残りが少なく、高い搬送波対雜音比(C/N)が得られる。

【0195】このようにして消去後に再書き込みする場合は、最初に照射する連続レーザ光のパワーレベルは、前記記録用レーザ光の高レベル(18mW)を1としたとき、0.4~1.1の範囲に設定するのが好ましい。この範囲であれば、良好な書き換えが行なえるからである。

【0196】この方法は、この発明の記録膜ばかりでなく他の記録膜にも有効である。

【0197】この実施例の情報記録媒体では、レーザ光のパワーを最適値より15%高くした厳しい条件で、記録・消去を10⁵回以上繰り返すことが可能であった。また、2MHzの信号を記録した時の再生信号のC/Nは、約50dBであり、極めて良好であった。

【0198】この実施例の記録膜3で、書き換え可能回数を10⁵回以上にすることは、記録膜3中に析出した高融点成分により、記録膜3の残成分(相変化部分)の流動・偏析が防止されたためと解される。

【0199】なお、記録膜3の上に形成されたZnS-SiO₂の中間層4とAl-Tiの反射層5とを省略した場合、前記よりも1桁少ない回数の記録・消去で多少の雜音増加が起こった。

【0200】(Te含有量yとの関係) 前記の(Ge₂S₂T₅)₇(Cr₄T₅)₃よりなる記録膜3において、他の元素の相対的比率を一定に保ちながらTe含有量yを変化させ、記録されている情報の消去に必要なレーザ光の照射時間と、レーザ光パワーを最適値より15%高くした厳しい条件で10⁵回書き換えた後の再生信号の搬送波対雜音比(C/N)の変化を測定した。その結果、次のようなデータが得られた。

【0201】

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消去に必要なレーザ光照射時間

$y = 34$	0. 5 μ sec
$y = 40$	0. 1 μ sec
$y = 50$	0. 1 μ sec
$y = 60$	0. 1 μ sec
$y = 67$	0. 5 μ sec
$y = 70$	1. 0 μ sec
$y = 75$	1. 5 μ sec
$y = 80$	5. 0 μ sec

10⁵回書き換後の再生信号のC/N

$y = 20$	42 dB
$y = 25$	46 dB
$y = 30$	49 dB
$y = 34$	50 dB
$y = 40$	50 dB
$y = 50$	50 dB
$y = 60$	50 dB

この結果より、Te含有量yが25≤y≤75の範囲に*

Sb ₃₀ Te ₆₀ Cr ₁₀
Sb ₂₈ Te ₅₈ Ge ₄ Cr ₁₀
Sb ₂₅ Te ₅₅ Ge ₁₀ Cr ₁₀
Sb ₂₂ Te ₅₁ Ge ₁₇ Cr ₁₀
Sb ₁₂ Te ₃₈ Ge ₄₀ Cr ₁₀
Sb ₂ Te ₂₈ Ge ₆₀ Cr ₁₀

結晶化温度

120°C
150°C
160°C
170°C
190°C
220°C

ピット・エラーレートの変化

Sb ₃₀ Te ₆₀ Cr ₁₀
Sb ₂₈ Te ₅₈ Ge ₄ Cr ₁₀
Sb ₂₅ Te ₅₅ Ge ₁₀ Cr ₁₀
Sb ₂₂ Te ₅₁ Ge ₁₇ Cr ₁₀
Sb ₁₂ Te ₃₈ Ge ₄₀ Cr ₁₀
Sb ₂ Te ₂₈ Ge ₆₀ Cr ₁₀

2倍
2倍
2倍
2. 5倍
4倍
5倍

上で組成を変化させ、一定速度で昇温した場合の結晶化温度と、80°C、相対湿度95%中に1000時間置いた時のピット・エラーレートの変化を測定した。その結果、次のようなデータが得られた。

【0204】

この結果より、Cr以外の組成が変化しても、十分高い結晶化温度が得られ、高温多湿下においてもピット・エラーレートの変化があまり大きくないことが分かる。

【0204】図6の三角相図のSb₄₅Te₄₅Cr₁₀とGe₁₈Te₇₂Cr₁₀を結ぶCr含有量を一定とした直線②

Sb ₂ Te ₇₁ Ge ₁₇ Cr ₁₀
Sb ₄ Te ₆₉ Ge ₁₇ Cr ₁₀
Sb ₈ Te ₆₇ Ge ₁₅ Cr ₁₀
Sb ₂₃ Te ₅₈ Ge ₉ Cr ₁₀
Sb ₃₀ Te ₅₄ Ge ₆ Cr ₁₀
Sb ₃₈ Te ₄₉ Ge ₃ Cr ₁₀
Sb ₄₁ Te ₄₇ Ge ₂ Cr ₁₀

210°C
200°C
190°C
170°C
150°C
130°C
110°C

ピット・エラーレートの変化

Sb ₂ Te ₇₁ Ge ₁₇ Cr ₁₀
Sb ₄ Te ₆₉ Ge ₁₇ Cr ₁₀
Sb ₈ Te ₆₇ Ge ₁₅ Cr ₁₀
Sb ₂₃ Te ₅₈ Ge ₉ Cr ₁₀

5倍
3倍
2倍
1. 5倍

*において、10⁵回という多数回の書き換えによる特性変化が少ないことが分かる。

【0202】(Cr以外の元素の組成との関係)図6の三角相図のGe₆₅Te₂₅Cr₁₀とSb₃₀Te₆₀Cr₁₀を結ぶCr含有量を一定とした直線①上で組成を変化させ、一定速度で昇温した場合の未記録部分の結晶化温度と、80°C、相対湿度95%中に1000時間置いた時のピット・エラーレートの変化を測定した。その結果、次のようなデータが得られた。

10 【0203】

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Sb₃₀Te₅₄Ge₆Cr₁₀
 Sb₃₈Te₄₉Ge₃Cr₁₀
 Sb₄₁Te₄₇Ge₂Cr₁₀

この結果より、Cr以外の組成が変化しても、十分高い結晶化温度が得られ、高温多湿下においてもビット・エラーレートの変化があまり大きくなことが分かる。

【0206】Geの含有量pとSbの含有量xの比(p/x)を変化させ、温度80°C、相対湿度95%中に1000時間置いた時のビット・エラーレートの変化を測定したところ、次の結果が得られた。

【0207】

ビット・エラーレートの変化

(p/x) = 0.15	2.0倍
(p/x) = 0.25	1.5倍
(p/x) = 0.5	1.5倍
(p/x) = 1.0	1.5倍
(p/x) = 2.0	3.0倍

この結果より、Geの含有量pとSbの含有量xの比 *

10⁵回書き換後の再生信号C/N

q = 0	42 dB
q = 3	46 dB
q = 4	48 dB
q = 10	50 dB
q = 20	50 dB
q = 34	48 dB

Crの含有量qを変化させると、レーザ光のパワーを最適値より15%高くした厳しい条件で10⁵回書き換えた後の再生信号の「消去比」は、次のように変化した。

【0210】ここで「消去比」とは、すでに記録された信号の上に周波数の異なる別の信号を重ね書きしたときの、重ね書き前後の信号の比をdBで表したものである。

【0211】

消去比

q = 22	25 dB
q = 34	23 dB
q = 40	20 dB
q = 50	17 dB

この結果より、Crの含有量qが増加するにつれて、消

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1.5倍
1倍
1倍

* (p/x)が、0.25 ≤ (p/x) ≤ 1.0の範囲であれば、ビット・エラーレートの変化が特に小さいことが分かる。

【0208】Cr₄Te₅の残部であるSb対Te対Geの含有量x, y, pの比を、x : y : p = 2 : 5 : 2に保ってCr₄Te₅の含有量を変化させたとき、レーザ光のパワーを最適値より15%高くした厳しい条件で10⁵回書き換えた後の再生信号のC/Nを測定したところ、Crの含有量qに関して次のような結果が得られた。

【0209】

※去比が低下することが分かる。

【0212】前記のCrを10%添加した系で、Teの含有量yを一定に保ってSbの含有量xを変化させた時、レーザ光のパワーを最適値より15%高くした厳しい条件で10⁵回書き換えた後の再生信号のC/Nは、次のように変化した。

【0213】

消去比

x = 38	48 dB
x = 30	50 dB
x = 15	50 dB
x = 8	50 dB
x = 4	48 dB
x = 2	46 dB
x = 0	45 dB

この結果より、Sbの含有量xが2%以上の範囲では、良好な再生信号のC/Nが得られることが分かる。

【0214】以上より、この実施例のSb₁₆Te₅₅Ge

16Cr₁₃、すなわち(Ge₂Sb₂Te₅)₇(Cr₄Te₅)₃の記録膜3は、温度80°C、相対湿度95%中に1000時間置いた時のビット・エラーレートの変化

は2倍以下、レーザ光のパワーを最適値より15%高くした厳しい条件で10⁵回書き換えた後の再生信号のC/Nおよび消去比は、それぞれ50dB以上および28dB以上であり、2×10⁵回以上の書き換えが可能で、極めて優れた特性を持つことが分かった。

【0215】(添加元素の他の例1) Crの一部または全部に代えて、Ag, Cu, Ba, Co, La, Ni, Pt, SiおよびSrおよびランタノイド元素のうちの少なくとも一つを添加しても、上記の場合とよく似た特性が得られる。例えば、Cuを添加した場合(Cuの添加量: q)、下記のようなデータが得られた。

【0216】

書き換え可能回数	
q=0	5×10 ⁴ 回
q=1. 0	8×10 ⁴ 回
q=4. 0	1×10 ⁵ 回
q=10. 0	2×10 ⁵ 回
q=20. 0	2×10 ⁵ 回
q=34. 0	2×10 ⁵ 回
q=40. 0	1×10 ⁶ 回

この結果より、Cuを添加すると、書き換え可能回数が顕著に増加することが分かる。

【0217】(添加元素の他の例2) Crに加えて、消去を高速化してC/Nを大きくする効果を持つTl(タリウム)を添加するのが好ましい。この場合、Crのみを添加した場合よりもC/Nがさらに大きくなり、また書き換え可能回数も大きくなるので、より好ましい。ただし、CrとTlの添加量の和を30原子%以下とする方が、消え残りが大きくならず、好ましい。CrとTlの添加量の和が0.5%以上、20原子%以下であれば、さらに好ましい。

【0218】例えば、Ge_{8.2}Sb_{16.4}Te_{64.4}Tl_{0.5}Cr_{10.5}記録膜では、C/N 50dB、書き換え可能回数2×10⁵回が得られた。

【0219】Tlの一部または全部に代えて、ハロゲン元素の少なくとも一つを添加してもよく似た特性が得られる。

【0220】Tlに代えてN(窒素)を添加した場合、書き換え可能回数がさらに向上する。ただし、多すぎると再生信号レベルが低下する。

【0221】(添加元素の他の例3) この他に、Tl(タリウム)をSeに置換し、他の元素の相対的比率を一定に保ちながらSeを1原子%以上、10原子%以下だけ添加すると、耐酸化性向上の効果がある。

【0222】(相変化成分の他の例) この実施例の相変化成分であるGe₂Sb₂Te₅の一部をGeSb₂Te₄, GeSb₄Te₇, In₃SbTe₂, In₃₅Sb₃₂Te₃₃, In₃₁Sb₂₆Te₄₃、およびこれらに近い組成のうちの少なくとも一つで置き換えても、Geの一部をInに置き換える、これに近い特性が得られる。

【0223】(高融点成分の他の例) 析出する高融点成分は、化合物でもよいし、元素単体や合金でもよい。この実施例の高融点成分であるCr₄Te₅の一部または全部をLaTe₂, La₂Te₃, La₃Te₄, LaTe, La₂Te₅, La₄Te₇, LaTe₃, La₃Te, La₂Sb, La₃Sb₂, LaSb, LaSb₂, La₃Ge, La₅Ge₃, La₄Ge₃, La₅Ge₄, LaGe, La₃Ge₅, Ag₂Te, Cr₅Te₈, Cr₂Te₃, CrSb, Cr₃Ge, Cr₅Ge₃, Cr₁₁Ge₈, CrGe, Cr₁₁Ge₁₉, PtTe₂, Pt₄Te₅, Pt₅Te₄, Pt₄Sb, Pt₃Sb₂, PtSb, Pt₃Ge, Pt₂Ge, Pt₃Ge₂, PtGe, Pt₂Ge₃, PtGe₃, NiTe, NiTe_{0.85}, NiSb, Ni₃Ge, Ni₅Ge₂, Ni₅Ge₃, NiGe, CoTe₂, CoSb₂, CoSb₃, Co₅Ge₂, Co₅Ge₃, CoGe, Co₅Ge₇, CoGe₂, Si₂Te₃, SiSb, SiGe, CeTe, Ce₃Te₄, Ce₂Te₃, Ce₄Te₇, CeTe₂, CeTe₃, Ce₂Sb, Ce₅Sb₃, Ce₄Sb₅, CeSb, CeSb₂, Ce₃Ge, Ce₅Ge₃, Ce₄Ge₃, Ce₅Ge₄, CeGe, Ce₃Ge₅, Ce₅Si₃, Ce₃Si₂, Ce₅Si₄, CeSi, Ce₃Si₅, CeSi₂, Cr₃Si, Cr₅Si₃, CrSi, CrSi₃, CrSi₂, Co₃Si, CoSi, CoSi₂, NiSi₂, NiSi, Ni₃Si₂, Ni₂Si, Ni₅Si₂, Ni₃Si, Pt₅Si₂, Pt₂Si, PtSi, LaS₂, Ag₃In, Ag₂In, Bi₂Ce, BiCe, Bi₃Ce₄, Bi₃Ce₅, BiCe₂, Cd₁₁Ce, Cd₆Ce, Cd₅₈Ce₁₃, Cd₃Ce, Cd₂Ce, CdCe, Ce₃In, Ce₂In, Ce_{1+x}In, Ce₃In₅, CeIn₂, CeIn₃, Ce₂Pb, CePb, CePb₃, Ce₃Sn, Ce₅Sn₃, Ce₅Sn₄, Ce₁₁Sn₁₀, Ce₃Sn₅, Ce₃Sn₇, Ce₂Sn₅, CeSn₃, CeZn, CeZn₂, CeZn₃, Ce₃Zn₁₁, Ce₁₃Zn₅₈, CeZn₅, Ce₃Zn₂₂, Ce₂Zn₁₇, CeZn₁₁, Cd₂₁C₅, CoGa, CoGa₃, CoSn, Cr₃Ga, CrGa, Cr₅Ga₆, CrGa₄, Cu₉Ga₄, Cu₃Sn, Cu₃Zn, Bi₂La, BiLa, Bi₃La₄, Bi₃La₅, BiLa₂, Cd₁₁La, Cd₁₇La₂, Cd₉La₂, Cd₂La, CdLa, Ga₆La, Ga₂La, GaLa, Ga₃La₅, GaLa₃, In₃La, In₂La, In₁La, In₁La₂, In₁La₃, La₅Pb₃, La₄Pb₃, La₁₁Pb₁₀, La₃Pb₄, La₅Pb₄, LaPb₂, LaPb₃, LaZn, LaZn₂, LaZn₄, LaZn₅, La₃Zn₂₂, La₂Zn₁₇, LaZn₁₁, LaZn₁₃, NiBi, Ga₃Ni₂, GaNi, Ga₂Ni₃, Ga₃Ni₅, GaNi₃, Ni₃Sn, Ni₃Sn₂, Ni₃Sn₄, NiZn, Ni₅Zn₂₁, PtBi, PtBi₂, PtBi₃, PtCd₂, Pt₂Cd₉, Ga₇Pt₃, Ga₂Pt, Ga₃Pt

t_2 , $GaPt$, Ga_3Pt_5 , $GaPt_2$, $GaPt_3$, In_7Pt_3 , In_2Pt , In_3Pt_2 , $InPt$, In_5Pt_6 , In_2Pt_3 , $InPt_2$, $InPt_3$, Pt_3Pb , $PtPb$, Pt_2Pb_3 , Pt_3Sn , $PtSn$, Pt_2Sn_3 , $PtSn_2$, $PtSn_4$, Pt_3Zn , $PtZn_2$, AlS , Al_2S_3 , BaS , BaC_2 , CdS , Co_4S_3 , Co_9S_8 , CoS , CoO , Co_2O_4 , Co_2O_3 , Cr_2O_3 , Cr_3O_4 , CrO , CrS , CrN , Cr_2N , Cr_23C_63 , Cr_7C_3 , Cr_3C_2 , Cu_2S , Cu_9S_5 , CuO , Cu_2O , In_4S_5 , In_3S_4 , La_2S_3 , La_2O_3 , Mo_2C , MoC , Mn_23C_6 , Mn_4C , Mn_7C_3 , NiO , Si_2S , SiO_2 , Si_3N_4 , 上記高融点成分の構成元素の酸化物のうち高融点のもの、 Cu_2Te , $CuTe$, Cu_3Sb , Mn_2Sb , $MnTe$, $MnTe_2$, Mn_5Ge_3 , $Mn_{3.25}Ge$, Mn_5Ge , Mn_3Ge_2 , Ge_3W , Te_2W , $AlSb$, Al_2Te_3 , Fe_2Ge , $FeGe_2$, $FeSb_2$, Mo_3Sb_7 , Mo_3Te_4 , $MoTe_2$, $PbTe$, $GePd_2$, Ge_2Pd_5 , Ge_9Pd_{25} , $GePd_5$, Pd_3Sb , Pd_5Sb_3 , $PdSb$, $SnTe$, Ti_5Ge_3 , Ge_3V_{17} , Ge_8V_{11} , Ge_3V_5 , GeV_3 , V_5Te_4 , V_3Te_4 , $ZnTe$, Ag_2Se , Cu_2Se , Al_2Se_3 , $InAs$, $CoSe$, Mn_3In , Ni_3In , Ni_1In , Ni_2In_3 , Ni_3In_7 , $PbSe$, などのB群の元素を含む高融点化合物、またはそれに近い組成のもの、あるいはこれらの混合組成や混合組成に近い3元以上の化合物のうちの少なくとも一つで置き換える、同様な結果が得られる。

【0224】これらのうちで、 $LaSb$, $CrSb$, $CoSb$, Cr_3Te_4 , $LaTe_3$, Cr_4Te_5 , Cr_2Te_3 , Cr_3Te_4 , $CoTe$, Co_3Te_4 , Cu_2Te , Cu_3Sb , $MnTe$, $MnTe_2$, Mn_2S *

$$a' = 5 \text{ 原子\%}$$

$$a' = 10 \text{ 原子\%}$$

$$a' = 20 \text{ 原子\%}$$

$$a' = 30 \text{ 原子\%}$$

$$a' = 30 \text{ 原子\%}$$

$$a' = 40 \text{ 原子\%}$$

$$a' = 50 \text{ 原子\%}$$

$$a' = 60 \text{ 原子\%}$$

この結果より、記録用薄膜中に含まれる高融点化合物の含有量 a' が増加すると、書き換え可能回数は増加するが、増加し過ぎると、 10^5 回書き換え後の消去比が低下することが分かった。よって、 $10 \text{ 原子\%} \leq a' \leq 50 \text{ 原子\%}$ の範囲が好ましいことが分かった。

【0230】(高融点成分の複素屈折率) 高融点成分の複素屈折率の実数部 n_1 と虚数部 (消衰係数) k_1 は、相変化成分の結晶化状態のそれらの値 n_2 , k_2 との差

* b のうちの少なくとも一つが特に好ましい。少ない回数の初期結晶化で記録・消去特性が安定するためである。

【0225】(高融点成分の含有量) 高融点成分の析出物に含まれる酸化物、硫化物、窒化物、炭化物の含有量は、高融点成分の40原子%未満とするのが好ましく、10原子%未満とするのが特に好ましい。これらの含有量が多いと、相変化成分との複素屈折率の差を小さくできなかったり、相変化成分中に酸素等が拡散して記録・読み出し特性を劣化させたりする問題を生じやすい。

【0226】高融点成分の例として述べた前記の多数の化合物では、遷移金属元素の含有量 v' が異なると、記録膜3の界面反射率は次のように変化した。

【0227】

界面反射率

$v' = 25 \text{ \%}$	1 %
$v' = 35 \text{ \%}$	2 %
$v' = 50 \text{ \%}$	6 %

この結果より、遷移金属元素の含有量 v' が増加すると、界面反射率が増加することが分かる。

【0228】(記録用薄膜中の高融点化合物の含有量) 記録用薄膜中に含まれる高融点化合物の含有量 a' を、その高融点化合物の構成元素の原子数の和の高融点成分の全構成元素の原子数の和に対する割合 (原子%) で表わし、その含有量 a' を変化させた場合、書き換え可能回数と、レーザパワーを15%高くした厳しい条件で 10^5 回書き換えた後の消去比は、次のように変化した。このC/Nの変化は、主としてCレベルの変化によるものである。

【0229】

書き換え可能回数

4×10^4 回
1×10^5 回
1.5×10^5 回
2×10^5 回

10^5 回書き換え後の消去比

30dB
30dB
25dB
23dB

$$\Delta n = (|n_1 - n_2| / n_1) \times 100,$$

$$\Delta k = (|k_1 - k_2| / k_1) \times 100$$

が異なる場合、レーザ光のパワーを最適値より15%高くした厳しい条件で 10^5 回書き換えた後、再生信号のC/Nは次のように変化した。このC/Nの変化は、主としてNレベルの変化によるものである。

【0231】

$\Delta k, \Delta n = 10\%$
 $\Delta k, \Delta n = 20\%$
 $\Delta k, \Delta n = 30\%$
 $\Delta k, \Delta n = 40\%$
 $\Delta k, \Delta n = 50\%$

この結果より、複素屈折率の実数部と虚数部（消衰係数）の差 Δn 、 Δk は小さい方が好ましいことが分かった。

【0232】（高融点成分の析出物の構成・寸法）前述したCr₄T₅などの高融点成分は、図1 (a) (b) (c) に示すような形態で記録膜3の内部に析出する。

【0233】図1 (a) では、多数の粒状の高融点成分3bの析出物が独立した状態で記録膜3内に分布している。記録膜3の高融点成分3b以外の部分、すなわち残成分が相変化成分3aである。高融点成分3bの膜面方向の長さと膜面に垂直な方向の長さとは、ほぼ同じであるか、異なっていてもそれら長さの差は小さい。ここでは、高融点成分3bの析出物のあるものは、記録膜3のいずれか一方の界面に接し、他のあるものはいずれの界面にも接していない。

【0234】図3の媒体では、高融点成分3bはCr₄T₅、相変化成分3aはGe₂Sb₂T₅より成っている。

【0235】図1 (b) では、多数の高融点成分3bの析出物が独立した状態で記録膜3内に分布している点は、図1 (a) の場合と同じである。しかし、高融点成分3bが柱状に析出している点が異なっている。すなわち、高融点成分3bの膜面方向の長さよりも、膜面に垂直な方向の長さの方が大きく、膜面に垂直な断面では柱状になっている。高融点成分3bの析出物のあるものは、記録膜3の一方の界面に接しており、他のあるものは、記録膜3の他方の界面に接している。ここでは、両方の界面に接しているものは存在していない。

【0236】図1 (c) では、多数の高融点成分3bの析出物が互いに連結され、一体的になった状態で記録膜3内に分布している。すなわち、高融点成分3bが多孔質状に析出し、その高融点成分3bの多数の小孔の中に相変化成分3aが埋め込まれた状態になっている。多孔質状の高融点成分3bは、記録膜3の両方の界面に接している。相変化成分3aは、互いに独立した状態で記録膜3中に分布している。この状態は、図1 (a) の場合において、相変化成分3aと高融点成分3bとを置き換えたものに相当する。

【0237】成膜条件や初期結晶化条件により、図1の (a) ~ (c) の状態のいずれかが出現するが、いずれの状態であっても、高融点成分3bにより、記録膜3を加熱・溶融させた場合の相変化成分3aの流动および偏析が防止され、その結果、書き換え可能回数が向上する。

49 dB
48 dB
47 dB
46 dB
43 dB

【0238】この発明においては、高融点成分3bの析出物の「最大外形寸法d'」、「高さhおよびh'」、「中心間距離」、「最大孔寸法」および「最大壁厚さ」

10 をそれぞれ次のように定義するものとする。

【0239】図1の (a) および (b) のように、高融点成分3bの析出物が独立して分布する場合、図2 (b) のように、記録膜3のいずれか一方の界面から記録膜3の膜厚Tの(1/3)の距離だけ離れた位置で記録膜3の膜面に平行な断面（以下、第1基準断面という）を考え、その断面における各高融点成分3bの析出物の長さを測定する。そして、任意の方向で測定した長さの最大値を「最大外形寸法d'」とする。

【0240】「最大外形寸法d'」は、具体的には、図2 (a) のように、第1基準断面における形状が円形または円形に近い場合は、析出物の直径を意味し、楕円形または楕円形に近い場合は、析出物の長径を意味し、多角形の場合は、析出物の最長の対角線の長さを意味する。

【0241】「高さh」は、記録膜3の膜面に垂直な断面（以下、第2基準断面という）を考え、その断面において、各高融点成分3bの析出物の記録膜3の膜面に垂直な方向の長さを測定する。こうして得られた長さを高融点成分3bの析出物の「高さh」とする。

【0242】この「高さh」は、図4 (a) に示すように、粒状の高融点成分3bの析出物が分布する場合と、図4 (b) に示すように、柱状の高融点成分3bの析出物が記録膜3の両方の界面に接して分布する場合とに適用される。

【0243】「高さh'」、「高さh''」は、前記「高さh」と同じ考え方であるが、図4 (c) に示すように柱状の高融点成分3bの析出物が記録膜3の片方の界面にのみ接して分布する場合、界面に接しない場合にそれぞれ適用される点のみが異なる。

【0244】「中心間距離i」は、図2 (a) に示すように、前記第1基準断面における、隣接する2つの高融点成分3bの析出物の中心間の距離の平均値を意味する。

【0245】「最大孔寸法p''」は、図1 (c) に示すように、多孔質の高融点成分3bが析出する場合に適用されるもので、前記第1基準断面における高融点成分3bの析出物の各孔の大きさの最大値を意味する。

【0246】この「最大孔寸法p''」は、具体的には、図5のように、第1基準断面における孔形状が円形または円形に近い場合は、孔の直径を意味し、楕円形ま

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たは橢円形に近い場合は、孔の長径を意味し、多角形の場合は、孔の最長の対角線の長さを意味する。

【0247】「最大壁厚さw」は、「最大孔寸法p'」と同様に、多孔質の高融点成分3bが析出する場合に適用されるもので、図5のように、前記第1基準断面において、高融点成分3bの析出物の隣接する2つの孔の間の壁の厚さの最大値を意味する。

【0248】(高融点成分の析出物の寸法との関係) 高*

書き換え可能回数	
$d' = 50 \text{ nm}$	$2 \times 10^5 \text{ 回}$
$d' = 30 \text{ nm}$	$2 \times 10^5 \text{ 回}$
$d' = 10 \text{ nm}$	$2 \times 10^5 \text{ 回}$
$d' = 5 \text{ nm}$	$1.5 \times 10^5 \text{ 回}$
$d' = 1 \text{ nm}$	$4 \times 10^4 \text{ 回}$
$10^5 \text{ 回書き換え後の再生信号のC/N}$	
$d' = 80 \text{ nm}$	46 dB
$d' = 50 \text{ nm}$	47 dB
$d' = 20 \text{ nm}$	49 dB
$d' = 15 \text{ nm}$	49 dB
$d' = 5 \text{ nm}$	50 dB

この結果より、 $5 \text{ nm} \leq d' \leq 50 \text{ nm}$ の範囲が好ましいことが分かった。

【0250】図4 (b) のように、柱状の高融点成分3bが記録膜3の両側の界面より析出した場合は、析出物の「高さh」が異なると、書き換え可能回数は次のように変化した。

【0251】

書き換え可能回数	
$h = 30 \text{ nm}$	$2 \times 10^5 \text{ 回}$
$h = 20 \text{ nm}$	$1.5 \times 10^5 \text{ 回}$
$h = 10 \text{ nm}$	$1 \times 10^5 \text{ 回}$
$h = 0 \text{ nm}$	$4 \times 10^4 \text{ 回}$

この結果より、 $10 \text{ nm} \leq h$ の範囲が好ましいことが分かった。

【0252】図4 (c) のように、柱状の高融点成分3bが記録膜3の片側の界面より析出した場合、析出物の「高さh」が異なると、書き換え可能回数は次のように変化した。

【0253】

書き換え可能回数	
$h' = 20 \text{ nm}$	$2 \times 10^5 \text{ 回}$
$h' = 10 \text{ nm}$	$1.5 \times 10^5 \text{ 回}$
$h' = 5 \text{ nm}$	$1 \times 10^5 \text{ 回}$
$h' = 1 \text{ nm}$	$4 \times 10^4 \text{ 回}$

柱状の高融点成分3bが記録膜3の界面に接していない場合、析出物の「高さh」が異なると、書き換え可

書き換え可能回数	
$i = 120 \text{ nm}$	$8 \times 10^4 \text{ 回}$
$i = 90 \text{ nm}$	$1.5 \times 10^5 \text{ 回}$
$i = 70 \text{ nm}$	$1.8 \times 10^5 \text{ 回}$

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*融点成分3bの析出物の「最大外形寸法d'」が異なる場合、書き換え可能回数と、レーザ光のパワーを最適値より15%高くした厳しい条件で 10^5 回書き換えた後の再生信号のC/Nは、次のように変化した。このC/Nの変化は、主としてNレベルの変化によるものである。

【0249】

能回数は次のように変化した。

【0254】

書き換え可能回数	
$h' = 20 \text{ nm}$	$2 \times 10^5 \text{ 回}$
$h' = 10 \text{ nm}$	$1.5 \times 10^5 \text{ 回}$
$h' = 5 \text{ nm}$	$1 \times 10^5 \text{ 回}$
$h' = 1 \text{ nm}$	$4 \times 10^4 \text{ 回}$

この結果より、 $5 \text{ nm} \leq h' \leq 20 \text{ nm}$ の範囲が好ましいことが分かった。

30 【0255】「中心間距離i」が異なる場合、書き換え可能回数と、レーザ光のパワーを最適値より15%高くした厳しい条件で 10^5 回書き換えた後の再生信号のC/Nは、次のように変化した。このC/Nの変化は、主としてCレベルの変化によるものである。

【0256】

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$i = 60 \text{ nm}$	2×10^5 回
$i = 40 \text{ nm}$	2×10^5 回
$i = 15 \text{ nm}$	2×10^5 回

10⁵回書き換え後の再生信号のC/N

$i = 70 \text{ nm}$	50 dB
$i = 40 \text{ nm}$	50 dB
$i = 30 \text{ nm}$	49 dB
$i = 20 \text{ nm}$	46 dB
$i = 15 \text{ nm}$	45 dB
$i = 10 \text{ nm}$	44 dB
$i = 5 \text{ nm}$	40 dB

この結果より、 $20 \text{ nm} \leq i \leq 90 \text{ nm}$ の範囲が好ましいことが分かった。

【0257】図1(c)のように、高融点成分3bが膜面方向につながって多孔質状として析出した場合、析出物の「最大孔寸法p''」が異なると、書き換え可能回数は次のように変化した。

【0258】

書き換え可能回数

$p'' = 50 \text{ nm}$	1. 5×10^6 回
$p'' = 60 \text{ nm}$	1. 5×10^6 回
$p'' = 80 \text{ nm}$	1×10^6 回
$p'' = 100 \text{ nm}$	4×10^4 回

この結果より、 $p'' \leq 80 \text{ nm}$ の範囲が好ましいこと*

10⁵回書き換え後の再生信号のC/N

$w = 5 \text{ nm}$	50 dB
$w = 15 \text{ nm}$	49 dB
$w = 20 \text{ nm}$	46 dB
$w = 35 \text{ nm}$	40 dB

この結果より、 $w \leq 20 \text{ nm}$ の範囲が好ましいことが分かった。

【0261】(高融点成分の融点との関係)記録膜3中に析出する高融点成分3bの融点(m. p.)が異なると、書き換え可能回数が次のように変化することが、計算機シミュレーションにより推測できた。

【0262】

書き換え可能回数

$m. p. = 600^\circ \text{C}$	7×10^4 回
$m. p. = 780^\circ \text{C}$	1. 5×10^6 回
$m. p. = 930^\circ \text{C}$	2×10^6 回

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この結果より、高融点成分3bの融点は 780°C 以上※

$$\begin{aligned} m. p. \text{ の差} &= 0^\circ \text{C} \\ m. p. \text{ の差} &= 150^\circ \text{C} \\ m. p. \text{ の差} &= 300^\circ \text{C} \end{aligned}$$

この結果より、融点の差は 150°C 以上の範囲が好ましく、 300°C 以上の範囲がより好ましいことが分かった。

【0265】(高融点成分と相変化分の結晶化温度の差との関係)毎分 10°C の一定速度で昇温し、結晶化の

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$i = 60 \text{ nm}$	2×10^5 回
$i = 40 \text{ nm}$	2×10^5 回
$i = 15 \text{ nm}$	2×10^5 回

10⁵回書き換え後の再生信号のC/N

$i = 70 \text{ nm}$	50 dB
$i = 40 \text{ nm}$	50 dB
$i = 30 \text{ nm}$	49 dB
$i = 20 \text{ nm}$	46 dB
$i = 15 \text{ nm}$	45 dB
$i = 10 \text{ nm}$	44 dB
$i = 5 \text{ nm}$	40 dB

*が分かった。

【0259】多孔質の高融点成分3bの「最大壁厚さw」が異なると、レーザ光パワーを最適値より15%高くした厳しい条件で 10^5 回書き換えた後の再生信号のC/Nは、次のように変化した。このC/Nの変化は、主としてCレベルの変化によるものである。

【0260】

30※の範囲が好ましく、 930°C 以上の範囲がより好ましいことが分かった。

【0263】高融点成分3bが析出した後の残成分(相変化成分3a)の融点と、高融点成分3bの融点との差が異なると、書き換え可能回数が次のように変化することも、計算機シミュレーションにより推測できた。

【0264】

書き換え可能回数

$m. p. \text{ の差} = 0^\circ \text{C}$	7×10^4 回
$m. p. \text{ の差} = 150^\circ \text{C}$	1. 5×10^6 回
$m. p. \text{ の差} = 300^\circ \text{C}$	2×10^6 回

発熱の始まる温度を測定した。その結果より、高融点成分3bと相変化を起こす低融点成分3aの結晶化温度の差sを求めるとき、温度差sによって書き換え可能回数は次のように変化した。

50 【0266】

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書き換え可能回数	
$s = 5^\circ C$	4×10^4 回
$s = 10^\circ C$	1×10^5 回
$s = 30^\circ C$	1.5×10^5 回
$s = 40^\circ C$	2×10^5 回

この結果より、融点の差は $10^\circ C$ 以上の範囲が好ましく、 $30^\circ C$ 以上の範囲がより好ましいことが分かった。

【0267】(成膜時に被着させる高融点成分との関係) この実施例の情報記録用薄膜を製作する際に、初期 $\ast 10$

書き換え可能回数	
$c' = 0 \text{ nm}$	5×10^4 回
$c' = 1 \text{ nm}$	1×10^5 回
$c' = 5 \text{ nm}$	2×10^5 回
10^5 回書き換え後の再生信号の C/N	
$c' = 1 \text{ nm}$	47 dB
$c' = 5 \text{ nm}$	47 dB
$c' = 10 \text{ nm}$	46 dB
$c' = 20 \text{ nm}$	40 dB

この結果より、 $1 \text{ nm} \leq c' \leq 10 \text{ nm}$ の範囲が好ましいことが分かった。

【0269】(その他) この実施例では、保護層2および中間層4を $ZnS-SiO_2$ により形成しているが、 $ZnS-SiO_2$ に代えて、 $Si-N$ 系材料、 $Si-O-N$ 系材料、 SiO_2 、 SiO 、 TiO_2 、 Al_2O_3 、 Y_2O_3 、 CeO 、 La_2O_3 、 In_2O_3 、 GeO 、 GeO_2 、 PbO 、 SnO 、 SnO_2 、 Bi_2O_3 、 TeO_2 、 WO_2 、 WO_3 、 Sc_2O_3 、 ZrO_2 などの酸化物、 TaN 、 AlN 、 Si_3N_4 、 $Al-Si-N$ 系材料(例えば $AlSiN_2$) などの窒化物、 ZnS 、 $SnSe$ 、 SnS_2 、 PbS 、 Bi_2S_3 などの硫化物、 $SnSe_2$ 、 $SnSe_3$ 、 $CdSe$ 、 $ZnSe$ 、 In_2Se_3 、 Ga_2Se_3 、 $GeSe$ 、 $GeSe_2$ 、 $SnSe$ 、 $PbSe$ 、 Bi_2Se_3 などのセレン化物、 CeF_3 、 MgF_2 、 CaF_2 などの弗化物、あるいは Si 、 Ge 、 TiB_2 、 B_4C 、 B 、 C 、または、上記の材料に近い組成のものを用いてよい。また、これらの混合材料の層やこれらの多重層でもよい。

【0270】中間層4を省略した場合には、記録感度が約30%低下し、消え残りも約5 dB増加した。書き換え可能回数も減少した。

【0271】中間層4の屈折率が1.7以上、2.3以下の範囲にある場合、膜厚が3 nm以上、100 nm以下の範囲、および180 nm以上、400 nm以下の範囲で、それぞれ50 dB以上のC/Nが得られた。

【0272】この実施例で反射層5に用いた $Al-Ti$ の代わりに、 Au 、 Ag 、 Cu 、 Al 、 Ni 、 Fe 、 Co 、 Cr 、 Ti 、 Pd 、 Pt 、 W 、 Ta 、 Mo 、 Sb の元素単体、またはこれらを主成分とする合金、あるいはこれら同志の合金よりなる層を用いてよいし、それら

*の工程で、高融点成分 Cr_4Te_5 を被着させているが、その高融点成分 Cr_4Te_5 の平均膜厚 c' を次のように変えると、書き換え可能回数と、レーザ光のパワーを最適値より15%高くした厳しい条件で 10^5 回書き換えた後の再生信号の C/N は、次のように変化した。この C/N の変化は、主として C レベルの変化によるものである。

【0268】

20 の層よりなる多重層を用いてもよいし、これらと酸化物などの他の物質との複合層などを用いてもよい。

【0273】この実施例では、表面に直接、トラッキングガイドなどの凹凸を形成したポリカーボネート基板1を用いているが、その代わりに、ポリオレフィン、エポキシ、アクリル樹脂、紫外線硬化樹脂層を表面に形成した化学強化ガラスなどを用いてもよい。

【0274】中間層4、反射層5および保護層2の一部を省略した単純積層構造、例えば基板1/保護層2/記録膜3、基板1/記録膜3/中間層4、基板1/記録膜3/反射層5などの構成でも、従来のものに比べると、多数回書き換えを行なってもノイズ上昇が少なく、良好な結果が得られた。

【0275】以上述べたように、この実施例の情報記録用薄膜は、記録・再生・消去特性を良好に保ちながら、従来より1桁以上の多数回の書き換えが可能である。また、記録・消去に用いるレーザ光のパワーが低くてよいという利点もある。

【0276】【実施例2】実施例1の $Sb-Te-Ge-Cr$ 系の記録膜5において、 Ge を In で全部置換したものに相当する $Sb-Te-In-Cr$ 系の $Cr_{12}In_{35}Sb_{12}Te_{40}$ 、すなわち $(Cr_4Te_5)_2(Ini_3Sb_2Te_2)_7$ により記録膜5を形成した点以外は、実施例1と同様にして、情報記録用薄膜を製作した。また、当該薄膜の初期結晶化と、その後の情報の記録・再生方法も実施例1と同様とした。

【0277】(Cr以外の元素の組成との関係) Cr含有量を一定として、三角相図(図示せず)の $In_{65}Te_{25}Cr_{10}$ と $Sb_{30}Te_{60}Cr_{10}$ を結ぶ直線上で他の組成を変化させると、一定速度で昇温した場合の未記録部分の結晶化温度と、 $80^\circ C$ 、相対湿度95%中に100

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0時間置いた時のビット・エラーレートの変化は、次のようになった。

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*【0278】

結晶化温度	
Sb ₃₀ Te ₆₀ Cr ₁₀	120°C
Sb ₂₂ Te ₅₁ In ₁₇ Cr ₁₀	140°C
Sb ₁₈ Te ₄₇ In ₂₅ Cr ₁₀	150°C
Sb ₁₀ Te ₃₅ In ₄₅ Cr ₁₀	170°C
Sb ₇ Te ₃₃ In ₅₀ Cr ₁₀	180°C
Sb ₂ Te ₈ In ₆₀ Cr ₁₀	220°C

ビット・エラーレートの変化

Sb ₂₂ Te ₅₁ In ₁₇ Cr ₁₀	2倍
Sb ₁₈ Te ₄₇ In ₂₅ Cr ₁₀	2倍
Sb ₁₀ Te ₃₅ In ₄₅ Cr ₁₀	2倍
Sb ₇ Te ₃₃ In ₅₀ Cr ₁₀	2.5倍
Sb ₂ Te ₈ In ₆₀ Cr ₁₀	4倍

この結果より、Cr以外の組成が変化しても、十分高い結晶化温度が得られ、10⁵回という多数回の書き換えによってもビット・エラーレートの変化があまり大きくないことが分かる。

【0279】Cr含有量を一定として、同じ三角相図の 20 【0280】

Sb₆₅Te₂₅Cr₁₀とIn₄₇Te₄₃Cr₁₀を結ぶ直線上※

※で組成を変化させると、一定速度で昇温した場合の結晶化温度と、80°C、相対湿度95%中に1000時間置いた時のビット・エラーレートの変化は、次のようになった。

結晶化温度	
Sb ₂ Te ₄₂ In ₄₆ Cr ₁₀	210°C
Sb ₄ Te ₄₂ In ₄₄ Cr ₁₀	200°C
Sb ₈ Te ₄₁ In ₄₁ Cr ₁₀	190°C
Sb ₁₅ Te ₃₉ In ₃₆ Cr ₁₀	180°C
Sb ₃₀ Te ₃₄ In ₂₆ Cr ₁₀	150°C
Sb ₃₈ Te ₃₂ In ₂₀ Cr ₁₀	130°C
Sb ₄₁ Te ₃₂ In ₁₇ Cr ₁₀	110°C

ビット・エラーレートの変化

Sb ₂ Te ₄₂ In ₄₆ Cr ₁₀	5倍
Sb ₄ Te ₄₂ In ₄₄ Cr ₁₀	3倍
Sb ₈ Te ₄₁ In ₄₁ Cr ₁₀	2倍
Sb ₁₅ Te ₃₉ In ₃₆ Cr ₁₀	1.5倍
Sb ₃₀ Te ₃₄ In ₂₆ Cr ₁₀	1.5倍
Sb ₃₈ Te ₃₂ In ₂₀ Cr ₁₀	1倍
Sb ₄₁ Te ₃₂ In ₁₇ Cr ₁₀	1倍

この結果より、Cr以外の組成が変化しても、十分高い結晶化温度が得られ、10⁵回という多数回の書き換えによってもビット・エラーレートの変化があまり大きくないことが分かる。

【0281】Inの含有量pとSbの含有量xの比(p★)

★/x)を変化させると、80°C、相対湿度95%中に1000時間置いた時のビット・エラーレートの変化

40 は、次のようになった。

【0282】

ビット・エラーレートの変化

(p/x) = 0.5	3.0倍
(p/x) = 1.0	2.0倍
(p/x) = 2.0	2.0倍
(p/x) = 3.0	2.0倍
(p/x) = 4.0	3.0倍

この結果より、Inの含有量pとSbの含有量xの比(p/x)が、1.0 ≤ (p/x) ≤ 3.0の範囲であ

れば、ビット・エラーレートの変化が小さいことが分かる。

【0283】CrをCuに代えたもの、すなわちIn-Sb-Te-Cu系において、同様にInの含有量pとSbの含有量xの比(p/x)を変化させた場合も、同様の結果が得られた。

【0284】(相変化成分の他の例)相変化成分であるIn₃SbTe₂の一部をGe₂Sb₂Te₅, GeSb₄Te₇, GeSb₂Te₄, In₃₅Sb₃₂Te₃₃, In₃₁Sb₂₆Te₄₃のうちの少なくとも一つで置き換える、Inの一部をGeに置き換える、近い特性が得られる。

【0285】(高融点成分の他の例)高融点成分であるCr₄Te₅の一部をLaTe₃, LaTe₂, La₂Te₃, La₃Te₄, LaTe, La₂Te₅, LaSb, La₄Te₇, La₃Te, La₂Sb, La₃Sb₂, LaSb₂, La₃Ge, La₅Ge₃, La₄Ge₃, La₅Ge₄, LaGe, La₃Ge₅, Ag₂Te, Cr₅Te₈, Cr₂Te₃, CrSb, Cr₃Ge, Cr₅Ge₃, Cr₁₁Ge₈, CrGe, Cr₁₁Ge₁₉, PtTe₂, Pt₄Te₅, Pt₅Te₄, Pt₄Sb, Pt₃Sb₂, PtSb, Pt₃Ge, Pt₂Ge, Pt₃Ge₂, PtGe, Pt₂Ge₃, PtGe₃, NiTe, NiTe_{0.85}, NiSb, Ni₃Ge, Ni₅Ge₂, Ni₅Ge₃, NiGe, CoTe₂, CoSb₂, CoSb₃, Co₅Ge₂, Co₅Ge₃, CoGe, Co₅Ge₇, CoGe₂, Si₂Te₃, SiSb, SiGe, CeTe, Ce₃Te₄, Ce₂Te₃, Ce₄Te₇, CeTe₂, CeTe₃, Ce₂Sb, Ce₅Sb₃, Ce₄Sb₅, CeSb, CeSb₂, Ce₃Ge, Ce₅Ge₃, Ce₄Ge₃, Ce₅Ge₄, CeGe, Ce₃Ge₅, Ce₅Si₃, Ce₃Si₂, Ce₅Si₄, CeSi, Ce₃Si₅, CeSi₂, Cr₃Si, Cr₅Si₃, CrSi, CrSi₃, CrSi₂, Co₃Si, CoSi, CoSi₂, NiSi₂, NiSi, Ni₃Si, Ni₃Si₂, Ni₂Si, Ni₅Si₂, Ni₃Si, Pt₅Si₂, Pt₂Si, PtSi, LaSi₂, Ag₂In, Ag₂In, Bi₂Ce, BiCe, Bi₃Ce₄, Bi₃Ce₅, BiCe₂, Cd₁₁Ce, Cd₆Ce, Cd₅Ce₁₃, Cd₃Ce, Cd₂Ce, CdCe, Ce₃In, Ce₂In, Ce_{1+x}In, Ce₃In₅, CeIn₂, CeIn₃, Ce₂Pb, CePb, CePb₃, Ce₃Sn, Ce₅Sn₃, Ce₅Sn₄, Ce₁₁Sn₁₀, Ce₃Sn₅, Ce₃Sn₇, Ce₂Sn₅, CeSn₃, CeZn, CeZn₂, CeZn₃, Ce₃Zn₁₁, Ce₁₃Zn₅₈, CeZn₅, Ce₃Zn₂₂, Ce₂Zn₁₇, CeZn₁₁, Cd₂₁Co₅, CoGa, CoGa₃, CoSn, Cr₃Ga, CrGa, Cr₅Ga₆, CrGa₄, Cu₉Ga₄, Cu₃Sn, Cu₃Zn, Bi₂La, BiLa, Bi₃La₄, Bi₃La₅, BiLa₂, Cd₁₁La, Cd₁₇La₂, Cd₉La₂, Cd₂La, CdLa, Ga₆La, Ga₂La, GaLa, Ga₃La₅, GaLa₃, In₃La, In₂La, In₅La₃, In_xLa, InLa, InLa₂, InLa₃, La₅Pb₃, La₄P

b₃, La₁₁Pb₁₀, La₃Pb₄, La₅Pb₄, LaPb₂, LaPb₃, LaZn, LaZn₂, LaZn₄, LaZn₅, La₃Zn₂₂, La₂Zn₁₇, LaZn₁₁, LaZn₁₃, NiBi, Ga₃Ni₂, GaNi, Ga₂Ni₃, Ga₃Ni₅, GaNi₃, Ni₃Sn, Ni₃S_{n2}, Ni₃Sn₄, NiZn, Ni₅Zn₂₁, PtBi, PtBi₂, PtBi₃, PtCd₂, Pt₂Cd₉, Ga₇Pt₃, Ga₂Pt, Ga₃Pt₂, GaPt, Ga₃Pt₅, GaPt₂, GaPt₃, In₇Pt₃, In₂Pt, In₃Pt₂, InPt, In₅Pt₆, In₂Pt₃, InPt₂, InPt₃, Pt₃Pb, PtPb, Pt₂Pb₃, Pt₃Sn, PtSn, Pt₂Sn₃, PtSn₂, PtSn₄, Pt₃Zn, PtZn₂, AlS, Al₂S₃, BaS, BaC₂, CdS, Co₄S₃, Co₉S₈, CoS, CoO, Co₂O₄, Co₂O₃, Cr₂O₃, Cr₃O₄, CrO, CrS, CrN, Cr₂N, Cr₂₃C₆₃, Cr₇C₃, Cr₃C₂, Cu₂S, Cu₉S₅, CuO, Cu₂O, In₄S₅, In₃S₄, La₂S₃, La₂O₃, Mo₂C, MoC, Mn₂₃C₆, Mn₄C, Mn₇C₃, NiO, SiS₂, SiO₂, Si₃N₄, Cu₂Te, CuTe, Cu₃Sb, Mn₂Sb, MnTe, MnTe₂, Mn₅Ge₃, Mn_{3.25}Ge, Mn₅Ge₂, Mn₃Ge₂, Ge₃W, Te₂W, AlSb, Al₂Te₃, Fe₂Ge, FeGe₂, FeSb₂, Mo₃Sb₇, Mo₃Te₄, MoTe₂, PbTe, GePd₂, Ge₂Pd₅, Ge₉Pd₂₅, GePd₅, Pd₃Sb, Pd₅Sb₃, PdSb, SnTe, Ti₅Ge₃, Ge₃₁V₁₇, Ge₈V₁₁, Ge₃V₅, GeV₃, V₅Te₄, V₃Te₄, ZnTe, Ag₂Se, Cu₂Se, Al₂Se₃, InAs, CoSe, Mn₃In, Ni₃In, NiIn, Ni₂In₃, Ni₃In₇, PbSe, 上記高融点成分の構成元素の酸化物のうち高融点のもの、などの高融点化合物、またはそれに近い組成のもの、あるいはこれらの混合組成や混合組成に近い3元以上の化合物のうちの少なくとも一つで置き換える、同様の結果が得られる。

【0286】これらのうちで、LaSb, La₂Te₃, La₃Te₄, CrSb, CoSb, Cr₃Te₄, Cr₂Te₃, Cr₃Te₄, CoTe, Co₃Te₄, Cu₂T_e, CuTe, Cu₃Sb, MnTe, MnTe₂, Mn₂Sb, Cr₄Te₅のうちの少なくとも一つが特に好ましい。少ない回数の初期結晶化で記録・消去特性が安定するからである。

【0287】この実施例においても、析出する高融点成分3bは化合物でもよいし、元素単体や合金でもよい。

【0288】(高融点成分の含有物の量)実施例1と同様に、高融点成分の析出物に含まれる酸化物、硫化物、窒化物、炭化物の含有量は、高融点成分の40原子%未満とするのが好ましく、10原子%未満とするのが特に好ましい。これらの含有量が多いと、相変化成分との複素屈折率の差を小さくできなかったり、相変化成分中に

酸素等が拡散して記録・再生特性を劣化させたりする問題を生じやすい。

【0289】なお、ここで述べていない事項は、実施例1と同様である。

【0290】【実施例3】実施例1のSb-Te-Ge-Cr系の記録膜5において、前記一般式でBまたはXで表される元素として、Crに代えてCoおよびSiを含むSb₁₆Te₃₉Ge₁₅Co₂₂Si₈すなわち(Co₃Si)₂₇(Ge₂Sb₂Te₅)₂₈により記録膜5を形成した点以外は、実施例1と同様にして、情報記録用薄膜を製作した。また、当該薄膜の初期結晶化と、その後の情報の記録・再生方法も実施例1と同様とした。

【0291】この実施例では、高融点成分はCo₃Si、相変化成分はGe₂Sb₂Te₅である。

【0292】Sb対Te対Geの含有量x, y, pの比をx:y:p=2:5:2に保ってCo₃Siの含有量a(実施例1のaに対応)を変化させたとき、書き換え可能回数と、レーザ光のパワーを最適値より15%高した厳しい条件で10⁵回書き換えた後の再生信号のC/Nの変化は、実施例1と同様であった。

【0293】(相変化成分の他の例)相変化成分であるGe₂Sb₂Te₅の一部または全部をGeSb₄Te₇、GeSb₂Te₄、In₃SbTe₂、In₃₅Sb₃₂Te₃₃、In₃₁Sb₂₆Te₄₃のうちの少なくとも一つで置き換える、Geの一部または全部をInに置き換えるも近い特性が得られる。

【0294】(高融点成分の他の例)高融点成分であるCo₃Siの一部または全部をCe₅Si₃、Ce₃Si₂、Ce₅Si₄、CeSi、Ce₃Si₅、CeSi₂、Cr₅Si₃、CrSi、CrSi₃、CrSi₂、Cr₃Si、CoSi、CoSi₂、NiSi₂、NiSi、Ni₃Si₂、Ni₂Si、Ni₃Si₂、Ni₃Si、Pt₅Si₂、Pt₂Si、PtSi、LaSi₂、Bi₂Ce、BiCe、Bi₃Ce₄、Bi₃Ce₅、BiCe₂、Cd₁₁Ce、Cd₆Ce、Cd₅₈Ce₁₃、Cd₃Ce、Cd₂Ce、CdCe、Ce₂Pb、CePb、CePb₃、Ce₃Sn、Ce₅Sn₃、Ce₅Sn₄、Ce₁₁Sn₁₀、Ce₃Sn₅、Ce₃Sn₇、Ce₂Sn₅、CeSn₃、CeZn、CeZn₂、CeZn₃、CeZn₁₁、Ce₁₃Zn₅₈、CeZn₅、Ce₃Zn₂₂、Ce₂Zn₁₇、CeZn₁₁、Cd₂₁Co₅、CoGa、CoGa₃、CoSn、Cr₃Ga、CrGa、Cr₅Ga₆、CrGa₄、Cu₉Ga₄、Cu₃Sn、Cu₃Zn、Bi₂La、BiLa、Bi₃La₄、Bi₃La₅、BiLa₂、Cd₁₁La、Cd₁₇La₂、Cd₉La₂、Cd₂La、CdLa、Ga₆La、Ga₂La、GaLa、Ga₃La₅、GaLa₃、La₅Pb₃、La₄Pb₃、La₁₁Pb₁₀、La₃Pb₄、La₅Pb₄、LaPb₂、LaPb₃、LaZn、LaZn₂、LaZn₄、LaZn₅、La₃Zn₂₂、La₂Zn₁₇、LaZn₁₁、LaZn₁₃、NiBi、Ga₃Ni₂、

GaNi、Ga₂Ni₃、Ga₃Ni₅、GaNi₃、Ni₃Sn、Ni₃Sn₂、Ni₃Sn₄、NiZn、Ni₅Zn₂₁、PtBi、PtBi₂、PtBi₃、PtCd₂、Pt₂Cd₉、Ga₇Pt₃、Ga₂Pt、Ga₃Pt₂、GaPt、Ga₃Pt₅、GaPt₂、GaPt₃、Pt₃Pb、PtPb、Pt₂Pb₃、Pt₃Sn、PtSn、Pt₂Sn₃、PtSn₂、PtSn₄、Pt₃Zn、PtZn₂

など、前記Bで表わされる元素を2以上含む高融点化合物、またはそれに近い組成のもの、あるいはこれらの混合組成や、混合組成に近い3元以上の化合物のうちの少なくとも一つで置き換えて、同様な結果が得られる。

【0295】ここで述べていない事項については、実施例1と同様である。

【0296】【実施例4】

(構成・製法)図3は、この発明の第1実施例の情報記録用薄膜を用いたディスク状情報記録媒体の断面構造を示す。この媒体は次のようにして製作された。

【0297】まず、直径13cm、厚さ1.2mmで表面に断面U字形のトラッキング溝を有するポリカーボネート基板1を形成した。次に、この基板1上に順次、薄膜を形成するため、基板1をマグネットロン・スパッタリング装置内に置いた。この装置は複数のターゲットを持ち、積層膜を順次、形成することができるものである。また、形成される膜厚の均一性および再現性に優れている。

【0298】マグネットロン・スパッタリング装置により、基板1上にまず(ZnS)80%・(SiO₂)20%、すなわち(Zn₄₀S₄₀Si₁₀O₁₃)膜よりなる保護層2を膜厚約130nmとなるように形成した。続いて、保護層2上に、高融点成分であるCr₄Te₅膜(図示せず)を島状に平均膜厚3nmまで形成した後、その上にCr₉Ge₇Sb₂₇Te₅₇、すなわち((GeSb₄Te₇)₈(Cr₄Te₅)₂)の組成の記録膜3を膜厚約22nmまで形成した。この際、Cr₄Te₅ターゲットとGeSb₄Te₇ターゲットとによる回転同時スパッタ法を用いた。

【0299】Cr₄Te₅膜は必ずしも形成する必要はない。しかし、その場合記録膜流動がやや起こりやすくなる。Cr₄Te₅膜を形成しない場合、記録膜3中に析出する高融点成分は、後述する初期化の際に生じるものとなる。

【0300】次に、記録膜3上に、(ZnS)80(SiO₂)20膜よりなる中間層4を約40nmの膜厚まで形成した後、その上に同じスパッタリング装置内でAl₁₉₇Ti₃膜よりなる反射層5を膜厚200nmまで形成した。こうして、第1のディスク部材を得た。

【0301】他方、まったく同様の方法により、第1のディスク部材と同じ構成を持つ第2のディスク部材を得た。第2のディスク部材は、直径13cm、厚さ1.2

mmの基板1'上に順に積層された、膜厚約130nmの(ZnS)₈₀(SiO₂)₂₀膜よりなる保護層2'、平均膜厚3nmのCr₄Te₅膜(図示せず)、膜厚約22nmのCr₉Ge₇S₂₇Te₅₇、すなわち((GeSb₄Te₁)₈(Cr₄Te₅)₂)の記録膜3'、膜厚約40nmの(ZnS)₈₀(SiO₂)₂₀膜よりなる中間層4'、および膜厚200nmのAl₉₇Ti₃膜よりなる反射層5'を備えている。

【0302】その後、接着剤層6を介して、前記第1および第2のディスク部材の反射層5, 5'同士を貼り合わせ、図3に示すディスク状情報記録媒体を得た。

【0303】この媒体では、反射層5, 5'の全面を接着すると、全面を接着しない場合に比べて書き換え可能回数を多くすることができ、また、反射層5, 5'の記録領域に対応する箇所に接着剤を付けない場合、その箇所にも接着剤を付けた場合よりも少し記録感度が高くなつた。

【0304】(初期化)前記のようにして製作した媒体の記録膜3, 3'に、次のようにして初期化を行なつた。なお、記録膜3'についてもまったく同様であるから、以下の説明では記録膜3についてのみ述べることとする。

【0305】媒体を1800rpmで回転させ、半導体レーザ(波長830nm)のレーザ光パワーを記録が行なわれないレベル(約1mW)に保ち、そのレーザ光を記録ヘッド中の開口数(NA)が0.55のレンズで集光し、基板1を通して記録膜3に照射した。記録膜3からの反射光を検出して、基板1のトラッキング溝の中心または溝と溝の中間にレーザ光スポットの中心が常に一致するようにトラッキングを行なうと共に、記録膜3上にレーザ光の焦点が来るよう、自動焦点合わせを行ないながら記録ヘッドを駆動した。

【0306】まず、初期化のため、記録膜5の同一記録トラック上に、パワー15mWの連続(DC)レーザ光を200回照射した。各回の照射時間(光スポット通過時間)は、約0.1μsecである。

【0307】続いて、パワー7mWの連続レーザ光を5回照射した。各回の照射時間(光スポット通過時間)は、約0.1μsecである。この時のレーザ光パワーは5~9mWの範囲であればよい。

【0308】前記2種類のレーザ光照射のうち、パワーの低い方(7mW)の照射は省略してもよいが、照射した方が消去特性が良い。

【0309】このように、パワーの異なるレーザ光を照射すると、初期化を充分に行なうことができる。

【0310】これらのレーザ光照射は、半導体レーザ・アレイを用いて行なうか、ガスレーザからの光ビームを複数に分割したもの、あるいは高出力ガスレーザや半導体レーザからの光ビームのスポット形状を媒体の半径方向に長い長円形にしたもの用いて行なえば、さらに好

ましい。こうすると、媒体を少數回転させるだけで初期結晶化を完了することも可能となる。

【0311】複数のレーザ光スポットを用いる場合、それらレーザ光スポットを同一の記録トラック上に配置せず、媒体の半径方向に位置を少しづつズラして配置すれば、1回の照射で広い範囲を初期化することができる、消え残りが少なくなる、などの効果が得られる。

【0312】次に、円形スポットの12mWの連続レーザ光(初期化用の高パワー光)を1回照射する(照射時間:約0.1μsec)毎に、パワー15mWのパルス・レーザ光(記録用の高パワー光)を照射し、記録膜5を非晶質化して記録点を形成した。その後、その記録点を7mWの連続レーザ光(消去用の低パワー光)を照射して結晶化させるために、7mWの連続レーザ光を何回照射することが必要かを調べた。

【0313】本実施例のディスクでは、12mWの連続レーザ光の照射回数が100回までは、照射回数が増加するほど、結晶化に要する前記7mWの連続レーザ光照射の回数は低下した。すなわち、照射回数が増加するほど結晶化しやすいことが分かった。これは、12mWの連続レーザ光の照射により、記録膜5中に高融点成分であるCr₄Te₅の微細な結晶が多数析出し、その残部(相変化する部分)の組成が高速結晶化可能なGeSb₄Te₁の組成に近づいたためと推察される。

【0314】一方、マークエッジ記録方式の信号を想定して、16T(1Tは4.5ns)の範囲で記録トラック上の信号書き始め位置をランダムにずらしながら2Tの記録マークと8Tのスペースの繰り返しに対応する信号Aと、8Tの記録マークと2Tのスペースの繰り返しに対応する信号Bとが交互に繰り返す信号を記録する場合、信号Aと信号Bとの切り替え部分ではマーク形成頻度が急に大きく変化するので、記録膜が流動すると、流動して来た記録膜材料が止められて堆積したり、後方からの流入なしに記録膜材料が流出して膜厚が薄くなったりするため、再生信号波形歪みが生ずる。記録膜中の元素が偏析する場合も、同様にその元素が対積したり不足したりする。流動や偏析はある程度起こると膜厚や濃度の勾配によって逆の流動や偏析も起こりやすくなり、ブレーキがかかる。従って、ディスクの使用前に記録領域より少し広めに高いパワー(15mW)連続光を繰り返し照射しておくと、上記のような記録領域内での変化はある程度防止できる。従って、ディスク毎に上記の信号の多数回書き換えによる波形歪みの大きさを指標にして、上記の連続光の繰り返し照射必要回数を求めた。上記のように、結晶化速度が十分大きくなるための照射の必要回数と、波形歪みが小さくなるための照射の必要回数の大きい方がそのディスクの初期化必要回数である。本実施例のディスクでは結晶化速度が十分大きくなるための必要回数の方が大きく、100回が必要初期化照射回数であった。

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【0315】なお、 Cr_4Te_5 の融点は 1252°C であり、 GeSb_4Te_7 の融点は 605°C である。

【0316】(Ge 含有量aとの関係 $1 : -\text{GeSb}_4\text{Te}_7$ 付近)図10の三角相図の $\text{Ge}_{65}\text{Te}_{25}\text{Cr}_{10}$ と $\text{Sb}_{30}\text{Te}_{60}\text{Cr}_{10}$ を結ぶCr含有量を一定とした直線*

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*①上で組成を変化させ、一定速度で昇温した場合の未記録部分の結晶化温度と、初期化のためのレーザ照射回数を測定した。その結果、次のようなデータが得られた。

【0317】

組成	結晶化温度	レーザ照射回数
$\text{Sb}_{30}\text{Te}_{60}\text{Cr}_{10}$	120°C	200回以下
$\text{Ge}_2\text{Sb}_{29}\text{Te}_{59}\text{Cr}_{10}$	130°C	200回以下
$\text{Ge}_4\text{Sb}_{28}\text{Te}_{58}\text{Cr}_{10}$	150°C	200回以下
$\text{Ge}_{10}\text{Sb}_{25}\text{Te}_{55}\text{Cr}_{10}$	160°C	200回以下
$\text{Ge}_{15}\text{Sb}_{23}\text{Te}_{52}\text{Cr}_{10}$	170°C	500回
$\text{Ge}_{17}\text{Sb}_{22}\text{Te}_{51}\text{Cr}_{10}$	170°C	2000回
$\text{Ge}_{25}\text{Sb}_{18}\text{Te}_{47}\text{Cr}_{10}$	180°C	5000回

この結果より、 $0.02 \leq a \leq 0.19$ の範囲において、適当な結晶化温度が得られ、初期化のためのレーザ照射回数を低減することができる。

【0318】(Sb 含有量bとの関係 $1 : -\text{GeSb}_4\text{Te}_7$ 付近)図10の三角相図の $\text{Sb}_{45}\text{Te}_{45}\text{Cr}_{10}$ と*

組成	結晶化温度	レーザ照射回数
$\text{Ge}_{17}\text{Sb}_{2}\text{Te}_{71}\text{Cr}_{10}$	210°C	5000回
$\text{Ge}_{17}\text{Sb}_{4}\text{Te}_{69}\text{Cr}_{10}$	200°C	1000回
$\text{Ge}_{14}\text{Sb}_{10}\text{Te}_{66}\text{Cr}_{10}$	180°C	500回
$\text{Ge}_{10}\text{Sb}_{20}\text{Te}_{60}\text{Cr}_{10}$	170°C	200回以下
$\text{Ge}_7\text{Sb}_{26}\text{Te}_{57}\text{Cr}_{10}$	160°C	200回以下
$\text{Ge}_5\text{Sb}_{33}\text{Te}_{52}\text{Cr}_{10}$	150°C	200回以下
$\text{Ge}_3\text{Sb}_{36}\text{Te}_{51}\text{Cr}_{10}$	140°C	200回以下
$\text{Ge}_2\text{Sb}_{40}\text{Te}_{48}\text{Cr}_{10}$	120°C	200回以下

この結果より、 $0.04 \leq b \leq 0.4$ の範囲において、適当な結晶化温度が得られ、初期化のためのレーザ照射回数を低減することができる。

【0320】(Te 含有量cとの関係 $1 : -\text{GeSb}_4\text{Te}_7$ 付近)図10の三角相図の $\text{Sb}_{15}\text{Te}_{75}\text{Cr}_{10}$ と $\text{Ge}_{30}\text{Sb}_{60}\text{Cr}_{10}$ を結ぶCr含有量を一定とした直線★

組成	レーザ光照射時間	の再生信号のC/N
$\text{Ge}_{14}\text{Sb}_{36}\text{Te}_{40}\text{Cr}_{10}$	$0.5\mu\text{sec}$	44dB
$\text{Ge}_{12}\text{Sb}_{33}\text{Te}_{45}\text{Cr}_{10}$	$0.2\mu\text{sec}$	48dB
$\text{Ge}_{11}\text{Sb}_{31}\text{Te}_{48}\text{Cr}_{10}$	$0.1\mu\text{sec}$	50dB
$\text{Ge}_8\text{Sb}_{27}\text{Te}_{55}\text{Cr}_{10}$	$0.1\mu\text{sec}$	50dB
$\text{Ge}_5\text{Sb}_{22}\text{Te}_{63}\text{Cr}_{10}$	$0.5\mu\text{sec}$	50dB
$\text{Ge}_3\text{Sb}_{19.5}\text{Te}_{67.5}\text{Cr}_{10}$	$1.0\mu\text{sec}$	50dB
$\text{Sb}_{15}\text{Te}_{75}\text{Cr}_{10}$	$3.0\mu\text{sec}$	50dB

この結果より、 $0.5 \leq c \leq 0.75$ の範囲において、消去に必要なレーザ光の照射時間を少なくでき、レーザ光パワーを最適値より15%高くした厳しい条件で 10^5 回書き換えた後の再生信号の搬送波対雑音比(C/N)を良くできる。

【0322】(Cr含有量dとの関係 $1 : -\text{GeSb}_4\text{Te}_7$ 付近) Cr_4Te_5 の残部であるGe対Sb対Te

の含有量a, b, cの比を、 $a : b : c = 1 : 4 : 7$ に保って Cr_4Te_5 の含有量を変化させたとき、レーザ光のパワーを最適値より15%高くした厳しい条件で 10^5 回書き換えた後の再生信号のC/Nを測定したところ、Crの含有量dに関して次のような結果が得られた。

【0323】

10⁵回書き換えた後の再生信号C/N

d = 0	4 2 dB
d = 3	4 8 dB
d = 10	5 0 dB
d = 20	5 0 dB
d = 34	4 8 dB

Crの含有量dを変化させると、レーザ光のパワーを最適値より15%高くした厳しい条件で初期化回数を200回として、信号を1回記録後、1回オーバーライトした時の再生信号の「消去比」は、次のように変化した。

【0324】ここで「消去比」とは、すでに記録された*10

信号を1回記録後、1回オーバーライトした時の再生信号の消去比

d = 10	2 8 dB
d = 20	2 5 dB
d = 30	2 5 dB
d = 40	2 0 dB

この結果より、Crの含有量dが増加するにつれて、消去比が低下することが分かる。

【0326】この結果より、0.03 ≤ d ≤ 0.3の範囲において、消去に必要なレーザ光の照射時間を少なくでき、レーザ光パワーを最適値より15%高くした厳しい条件で10⁵回書き換えた後の再生信号の搬送波対雜音比(C/N)を良くできる。

【0327】記録用薄膜の平均組成を、元素単体または※

組成	10 ⁵ 回書き換えた後の	
	再生信号のC/N	結晶化温度
(GeSb ₄ Te ₇) ₉₅ (Cr ₄ Te ₅) ₅	4 5 dB	170°C
(GeSb ₄ Te ₇) ₉₀ (Cr ₄ Te ₅) ₁₀	4 8 dB	170°C
(GeSb ₄ Te ₇) ₈₀ (Cr ₄ Te ₅) ₂₀	5 0 dB	160°C
(GeSb ₄ Te ₇) ₆₅ (Cr ₄ Te ₅) ₃₅	5 0 dB	150°C
(GeSb ₄ Te ₇) ₅₀ (Cr ₄ Te ₅) ₅₀	5 0 dB	130°C
(GeSb ₄ Te ₇) ₄₀ (Cr ₄ Te ₅) ₆₀	4 9 dB	120°C

この結果より、20 ≤ k / (j + k) ≤ 40の範囲が好ましいことが分かった。

【0329】(成膜時に被着させる高融点成分との関係)この実施例の情報記録用薄膜を製作する際に、初期の工程で、高融点成分Cr₄Te₅を被着させているが、その高融点成分Cr₄Te₅の平均膜厚zを次のように変

*信号の上に周波数の異なる別の信号を重ね書きしたときの、重ね書き前後の信号の比をdBで表したものである。

【0325】

※化合物組成の低融点成分Lと元素単体または化合物組成の高融点成分Hにより

L / H_k
20 の式で表わし、その含有量kを変化させた場合、結晶化温度とレーザパワーを15%高くした厳しい条件で10⁵回書き換えた後の再生信号のC/Nは、次のように変化した。

【0328】

★えると、書き換え可能回数と、レーザ光のパワーを最適値より15%高くした厳しい条件で10⁵回書き換えた後の再生信号のC/Nは、次のように変化した。このC/Nの変化は、主としてCレベルの変化によるものである。

【0330】

書き換え可能回数

z = 0 nm	5 × 10 ⁴ 回
z = 1 nm	1 × 10 ⁵ 回
z = 5 nm	2 × 10 ⁵ 回

10⁵回書き換えた後の再生信号のC/N

z = 1 nm	4 7 dB
z = 5 nm	4 7 dB
z = 10 nm	4 6 dB
z = 20 nm	4 0 dB

この結果より、1 nm ≤ z ≤ 10 nmの範囲が好ましいことが分かった。

【0331】(その他、保護層および中間層および反射

層材質)この実施例では、保護層2および中間層4をZnS-SiO₂により形成しているが、ZnS-SiO₂に代えて、Si-N系材料、Si-O-N系材料、Si

O₂, SiO, TiO₂, Ta₂O₅, Al₂O₃, Y₂O₃, CeO, La₂O₃, In₂O₃, GeO, GeO₂, PbO, SnO, SnO₂, Bi₂O₃, TeO₂, WO₂, WO₃, Sc₂O₃, ZrO₂などの酸化物, TaN, AlN, Si₃N₄, Al-Si-N系材料(例えばAlSiN₂)などの窒化物, ZnS, Sb₂S₃, CdS, In₂S₃, Ga₂S₃, GeS, SnS₂, PbS, Bi₂S₃, などの硫化物, SnSe₂, Sb₂Se₃, CdSe, ZnSe, In₂Se₃, Ga₂Se₃, GeSe, GeSe₂, SnSe, PbSe, Bi₂Se₃などのセレン化物, CeF₃, MgF₂, CaF₂などの弗化物、あるいはSi, Ge, TiB₂, B₄C, B, C, または、上記の材料に近い組成のものを用いてもよい。また、これらの混合材料の層やこれらの多重層でもよい。

【0332】多重層の場合、ZnSを70モル%以上含む材料、例えば(ZnS)₈₀(SiO₂)₂₀と、Si, Geのうちの少なくとも一者を70原子%以上含む材料、例えばSi、あるいはSiの酸化物、例えばSiO₂との2層膜が好ましい。この場合、記録感度低下を防ぐため、ZnS-SiO₂層の方を記録膜側に設け、その厚さを3nm以上とする。また、SiO₂などの層の低熱膨張係数による記録膜流動抑制効果を発揮するために、厚さ10nm以下が好ましい。この2層膜は保護層2の代わりに設けると好ましいが、中間層4の代わりに設けてもよい。保護層2の代わりとしてはSiO₂などの層の厚さが50nm以上250nm以下が好ましい。中間層の代わりに2層膜を設ける場合は、SiO₂層の膜厚は10nm以上80nm以下が好ましい。これらの2層膜を設けることは、本発明の記録膜を用いる場合だけではなく、他の相変化記録膜を用いる場合にも好ましい。

【0333】また、ZnS-SiO₂と基板側にAu層を設けた2層膜にすると反射率決定の自由度が増すため、好ましい。このときのAu層の厚さは30nm以下が好ましい。Auの代わりにたとえばAu-Co, Au-Cr, Au-Ti, Au-Ni, Au-AgなどAuを主成分とする混合材料を用いてもよい。

【0334】中間層4を省略した場合には、記録感度が約30%低下し、消え残りも約5dB増加した。書き換え可能回数も減少した。

【0335】中間層4の屈折率が1.7以上、2.3以下の範囲にある場合、膜厚が3nm以上、100nm以下の範囲、および180nm以上、400nm以下の範囲で、それぞれ50dB以上のC/Nが得られた。

【0336】この実施例で反射層5に用いたAl-Tiの代わりに、反射層の材料としては、Si-Ge混合材料が、記録マーク部分の光吸収率を記録マーク以外の部分の光吸収率より小さくできるので、光吸収率差による消え残りを防止でき、さらに書き換え可能回数が低下しない。Geの含有量は10原子%以上80原子%以下が

書き換え可能回数が低下が生じにくい。

【0337】次いで、Si-SnまたはSi-In混合材料、あるいはこれら混合材料の2種以上の混合材料でも同様の結果が得られた。これらの反射層材料は、本発明の相変化膜ばかりでなく、他の相変化膜を用いる場合の反射層材料として用いても、従来の反射層材料に比べて、書き換え可能回数が低下しない。

【0338】さらに、Si, Ge, C, Au, Ag, Cu, Al, Ni, Fe, Co, Cr, Ti, Pd, Pt, W, Ta, Mo, Sbの元素単体、またはこれらを主成分とする合金、あるいはこれら同志の合金よりなる層を用いてもよいし、それらの層よりなる多重層を用いてもよいし、これらと酸化物などの他の物質との複合層などを用いてもよい。

【0339】この実施例では、表面に直接、トラッキングガイドなどの凹凸を形成したポリカーボネート基板1を用いているが、その代わりに、ポリオレフィン、エポキシ、アクリル樹脂、紫外線硬化樹脂層を表面に形成した化学強化ガラスなどを用いてもよい。

【0340】中間層4、反射層5および保護層2の一部を省略した単純積層構造、例えば基板1/保護層2/記録膜3、基板1/記録膜3/中間層4、基板1/記録膜3/反射層5などの構成でも、従来のものに比べると、多数回書き換えを行なってもノイズ上昇が少なく、良好な結果が得られた。

【0341】以上述べたように、この実施例の情報記録用薄膜は、記録・再生・消去特性を良好に保ちながら、従来より多数回の書き換えが可能である。また、記録・消去に用いるレーザ光のパワーが低くてよいという利点もある。

【0342】なお、ここで述べていない事項は、実施例1と同様である。

【0343】(実施例5) 実施例1のGe-Sb-Te-Cr系の記録膜5においてGe₅₀Te₅₀組成付近の組成Ge₄₀Sb₁₀Te₄₀Cr₁₀により記録膜5を形成した。構造は、保護層の下に金属層を15nm、保護層を20nm、記録膜を20nm、中間層を40nm、反射層を70nm形成した。材料は、金属層と反射層にAuを使用した。それ以外は、実施例1と同様にして、情報記録用薄膜を作製した。また、当該薄膜の初期化と、その後の情報の記録再生方法も実施例と同様とした。

【0344】(Sb含有量bとの関係-2:GeTe組成付近) 図11の三角相図のGe₄₅Te₄₅Cr₁₀とSb₉₀Cr₁₀を結ぶCr含有量を一定とした直線④上で組成を変化させ、非晶質化させた時と結晶化させた時の反射率差を測定した。その結果、次のようなデータが得られた。

【0345】

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組成	反射率差
$Ge_{45}Te_{45}Cr_{10}$	50%
$Ge_{43}Sb_4Te_{43}Cr_{10}$	51%
$Ge_{40}Sb_{10}Te_{40}Cr_{10}$	51%
$Ge_{37}Sb_{10}Te_{37}Cr_{10}$	44%
$Ge_{35}Sb_{20}Te_{35}Cr_{10}$	30%

これより、 $GeTe$ 組成付近においては、 $0 \leq b \leq 0.2$ の範囲で高反射率差が得られることがわかった。 Sb を $0.01 \leq b \leq 0.2$ の範囲で添加すると、 60 相対湿度80%におけるクラック発生を防止できた。しかし、 Sb を添加しない膜より細かい組成制御が要求される。

【0346】(Ge , Te 含有量 a , c との関係-2: $GeTe$ 組成付近) 図11の三角相図の $Sb_{10}Te_{80}Cr_{10}$ と $Ge_{80}Sb_{10}Cr_{10}$ を結ぶ Cr 含有量を一定とした直線⑥上で組成を変化させ、非晶質化させた時と結晶化させた時の反射率差を測定した。その結果、次のようなデータが得られた。

【0347】*

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組成	反射率差
$Ge_{15}Sb_{10}Te_{65}Cr_{10}$	35%
$Ge_{20}Sb_{10}Te_{60}Cr_{10}$	45%
$Ge_{28}Sb_{10}Te_{52}Cr_{10}$	50%
$Ge_{40}Sb_{10}Te_{40}Cr_{10}$	51%
$Ge_{52}Sb_{10}Te_{28}Cr_{10}$	46%
$Ge_{60}Sb_{10}Te_{20}Cr_{10}$	36%

これより、 $GeTe$ 組成付近においては、 $0.25 \leq a \leq 0.65$, $0.35 \leq c \leq 0.75$ の範囲で高反射率差が得られることがわかった。

【0348】(Cr 含有量 d との関係-2: $GeTe$ 組成付近) Cr_4Te_5 の残部である Ge 対 Sb 対 Te の含有量 a , b , c の比を、 $a:b:c = 4:1:4$ に保つて Cr_4Te_5 の含有量を変化させたとき、レーザ光のパワーを最適値より15%高くした厳しい条件で 10^5 回書き換えた後の再生信号の C/N を測定したところ、 Cr の含有量 d に関して次のような結果が得られた。

【0349】

10⁵回書き換えた後の再生信号 C/N

$d = 0$	42 dB
$d = 3$	48 dB
$d = 10$	50 dB
$d = 20$	50 dB
$d = 34$	48 dB

Cr の含有量 d を変化させると、レーザ光のパワーを最適値より15%高くした厳しい条件で初期化回数を200回として、信号を1回記録後、1回オーバーライトした時の再生信号の「消去比」は、次のように変化した。

【0350】ここで「消去比」とはすでに記録された信号を1回記録後、1回オーバーライトした時の再生信号の消去比

$d = 10$	28 dB
$d = 20$	25 dB
$d = 30$	25 dB
$d = 40$	20 dB

この結果より、 Cr の含有量 d が増加するにつれて、消去比が低下することが分かる。

【0352】この結果より、 $0.03 \leq d \leq 0.3$ の範囲において、十分高い消去比が得られ、レーザ光パワーを最適値より15%高くした厳しい条件で 10^5 回書き換えた後の再生信号の搬送波対雑音比(C/N)を良くできる。

【0353】なお、ここで述べていない事項は、実施例1と同様である。

【0354】【実施例6】実施例1の記録膜5において、前記高融点成分が膜厚方向に変化した記録膜を形成した点以外は、実施例1と同様にして情報記録用薄膜を

スパッタ時間 スパッタパワー (W)

※号の上に周波数の異なる別の信号を重ね書きしたときの、重ね書き前後の信号の比をdBで表したものである。

【0351】

40 作製した。また、その他は1実施例の用いたディスク状情報記録媒体と同様に作製した。初期化、その後の記録

・再生方法も実施例1と同様にした。

【0355】(構成・製法) 前記高融点成分の含有量が膜厚方向に変化した記録膜の形成には、マグネットロン・スパッタリング装置による、 Cr_4Te_5 ターゲットと $GeSb_4Te_7$ ターゲットとの回転同時スパッタ法を用いた。この際、始めに Cr_4Te_5 膜を3nm形成しておき、その後次に示すように $GeSb_4Te_7$ ターゲットに印加する電圧を一定にし、 Cr_4Te_5 ターゲットに印加する電圧を徐々に下げていった。

【0356】

光入射側からの Cr_4Te_5 含有

(秒)	GeSb ₄ Te ₇ ターゲット	Cr ₄ Te ₅ ターゲット	記録膜膜厚 (nm)	(原子%)
0~9	4.9	1.50	0~6	5.0
10~20	4.9	1.00	6~12	4.0
21~33	4.9	0.65	1.3~1.8	3.0
34~47	4.9	0.40	1.9~2.4	2.0
48~63	4.9	0.20	2.4~3.0	1.0

この他にも、Cr₄Te₅ターゲットに印加する電圧を一定にし、GeSb₄Te₇ターゲットに印加する電圧を徐々に上げていっても、高融点成分の含有量が膜厚方向に変化した記録膜を形成できる。印加電圧は徐々に変化させた方が、記録特性が良かった。また、インラインスピッタ装置において、Cr₄Te₅組成の面積とGeSb₄Te₇組成の面積を徐々に変化させたターゲットを仕様し同様に作製できる。この記録膜を持つディスクを作製した。

【0357】このディスクは、実施例1のように高融点成分の含有量が膜厚方向に一定の記録膜に比べ、作製が複雑になるが、初期化のためのレーザ照射回数を低減できた。

【0358】ここで述べていない事項については、実施例1と同様である。

【0359】【実施例7】図12は、本発明による超解像読み出し膜を用いたディスクの構造断面図の一例を示したものである。

【0360】図12のディスクの製造にあたっては、まず、直径13cm、厚さ1.2mmの、凹凸で情報が記録されたポリカーボネイト基板11を形成した。次に、この基板を複数のターゲットを備えて順次積層膜を形成でき、また、膜厚の均一性、再現性のよいマグネットロンスピッタリング装置内に取付け、この基板上に厚さ1.25nmの(ZnS)₈₀(SiO₂)₂₀層12を形成した。続いて、Cr₄Te₅ターゲットを高周波電源で、GeSb₂Te₄ターゲットを直流電源で同時スピッタして、超解像読み出し膜である(Cr₄Te₅)₂₀(GeSb₂Te₄)₈₀膜13を30nm形成した。次に(ZnS)₈₀(SiO₂)₂₀層14を20nm、Al₁₉₇Ti₃層15を100nmの膜厚に順次積層した。その後、この上に接着層16を介してポリカーボネイト基板11'を貼りあわせた。

【0361】一般に、薄膜に光を照射すると、薄膜の表面からの反射光と薄膜の裏面からの反射光との重ね合わせにより干渉が生じる。そこで、超解像読み出し用薄膜の反射率の変化を大きくしたい場合には、薄膜に近接して光を反射する「反射層」を設けることにより、干渉の効果を大きくすることができる。なお、光を吸収する吸収層としてもよい。図1のAl₁₉₇Ti₃層15は、この反射層の役割を果たす。

【0362】干渉の効果をより大きくするためには、超解像読み出し用薄膜と反射層の間に「中間層」を設ける

のが好ましい。中間層は、超解像読み出し時に超解像読み出し用薄膜と反射層との間で相互拡散が起こるのを防止する作用、及び反射層への熱の逃げを減少させて読み出し感度を高め、また超解像読み出し後に膜を結晶化させる働きがある。図12の(ZnS)₈₀(SiO₂)₂₀層14はこの中間層の作用をする。

【0363】前記超解像読み出し用薄膜13の少なくとも一方の界面は、他の物質に密着して保護されているのが好ましく、両側の界面が保護されていればさらに好ましい。この保護は、基板により行なってもよいし、基板とは別に形成した保護層により行なってもよい。「保護層」の形成により、超解像読み出し時の薄膜の変形に起因するノイズ増加を防止することができる。図12の(ZnS)₈₀(SiO₂)₂₀層12はこの保護層の作用をする。

【0364】超解像読み出し膜13の厚さは、図13に示す結晶化状態と非晶質状態の反射率の測定結果より決定した。図2に示されるように、膜厚が30nmのとき、結晶化状態の反射率が非晶質状態より大きく、結晶化状態と非晶質状態の反射率差が最大になるため、(Cr₄Te₅)₂₀(GeSb₂Te₄)₈₀膜13の膜厚は30nmに設定した。

【0365】上記のように作製したディスクはまず、次のようにして初期化を行なった。フラッシュ光で、予備結晶化を行なったあとディスクを1800rpmで回転させ、半導体レーザの光強度を超解像読み出しが行なわれないレベル(約1mW)に保ち、記録ヘッド中のレンズで集光して基板11を通して読み出し膜13に照射し、反射率を検出することによって、トラッキング用の溝の中心に光スポットの中心が常に一致するようにヘッドを駆動した。このようにトラッキングを行いながら、さらに超解像読み出し膜上に焦点が合うように自動焦点合わせを行い、まず初期結晶化のため、同一トラック上にパワー1.1mWの連続レーザ光を5回照射した。この照射パワーは9~18mWの範囲でよい。続いて6mWの連続レーザ光を3回照射した。この照射パワーは4~9mWの範囲でよい。上記2種類の照射は1回以上であればよいが、パワーの高いほうの照射は2回以上がより好ましい。

【0366】高融点成分を含む超解像読み出し膜では、C/Nを良くするためには、初期結晶化を十分に行なうことが重要である。このため初期結晶化は低パワーでの照射を重点的に行い、同一トラック上にパワー6mWの連

続レーザ光を500回照射し、続いて11mWの連続レーザ光を3回、6mWの連続レーザ光を10回照射した。時間がかかるが、6mW500回、11mW3回のレーザ照射を数回繰り返すと、さらにC/N及び超解像読み出し可能回数が増加した。

【0367】これらの照射は、半導体レーザアレイで行うか、ガスレーザからの光ビームを複数に分割したもの、あるいは高出力ガスレーザや半導体レーザからの光ビームをディスクの半径方向に長く整形した長円ビームで行うと、ディスクの1回転で全てのトラックに対して同時に使うことも可能である。複数の光スポットを同一トラック上に配置せず、ディスクの半径方向に位置を少しずらして配置すれば、広い範囲をイニシャライズすることができ、消え残りが少なくなるなどの効果がある。

【0368】また、初期化の最後に、溝間にトラッキングを行なながら連続レーザ光を照射する方法で、トラック周辺部も結晶化を行うと、クロストークを2dB低減することができた。結晶化にあたっては、パワーを6mWにして連続光の照射を行った。

【0369】超解像効果による超解像読み出しの原理は、次の通りである。図8において、31はレーザ光などの光スポット、32a、32bは基板1の表面に形成された記録マークである。光スポット径は、光強度がそのピーク強度の $(1/e^2)$ になる位置での光ビームの直径として定義される。記録マークの最小ピッチは、光スポット31のスポット径よりも小さく設定されている。

【0370】光スポット内の高温領域では、超解像読み出し膜中の少なくとも相変化成分GeS_{b2}T_{e4}が融解して、複素屈折率の実数部nまたは虚数部kの少なくとも一方が低下するため、反射率の低下が起こる。そこで、光スポット31内には2つの記録マーク32a、3*

マークサイズ(μm)	超解像読み出し 膜あり(dB)	超解像読み出し 膜なし(dB)
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0.3	30	—
0.4	43	30
0.5	47	35
0.6	49	40
0.7	50	46
0.8	50	50

保護膜、中間層のうちの少なくとも一者に用いているZnS-SiO₂の代わりにSi-N系材料、Si-O-N系材料、SiO₂、SiO、TiO₂、Al₂O₃、Y₂O₃、CeO、La₂O₃、In₂O₃、GeO、GeO₂、PbO、SnO、SnO₂、Bi₂O₃、TeO₂、WO₂、WO₃、Sc₂O₃、ZrO₂やTaN、AlN、Al₁N₂、Si₃N₄などのAl-Si-N系材料などの酸化物や窒化物、ZnS、Sb₂S₃、CdS、In₂S₃、Ga₂S₃、GeS、SnS₂、PbS、Bi₂S

*2bがあるにもかかわらず、超解像読み出し層13によって高温領域35内にある記録マーク32bが隠されるため、実際には記録マーク32aのみが検出される。換言すれば、実際の検出範囲34が、図8のように、光スポット31の円形の領域からマスクとして働く範囲33、すなわち光スポット31と高温領域35の重複箇所を除いた三日月形の領域となる。こうして、光スポット径より小さい記録マークを超解像読み出しすることが可能となる。

10 【0371】超解像読み出しを行う部分では、レーザパワーを8mWにして一定に保ち、超解像読み出しを行った。このパワーは、超解像読み出し膜の融点により異なる。超解像読み出し部分を通り過ぎれば、レーザパワーを1mWに下げてトランкиング及び自動焦点合わせを続けた。レーザパワーを1mWに下げることは、マスク層の劣化を防ぐのに効果があった。なお、超解像読み出しもトランкиング及び自動焦点合わせは継続される。トランкиング及び自動焦点合わせ用レーザパワーP_tと超解像読み出し用レーザパワーP_rの関係は次式に示される範囲内で、良好な超解像読み出し特性が得られた。

【0372】P_r/P_t ≥ 2
超解像読み出し後、超解像読み出し膜が非晶質化したままになるディスクでは、結晶化しておく必要があった。読み出し後、再び結晶化する膜組成のディスクについては、結晶化は不要であった。

【0373】本実施例の超解像読み出し膜を用いたディスクと超解像読み出し膜を用いないディスクで、異なるサイズのマークを超解像読み出した際のC/Nを比較したところ、次のように本実施例の超解像読み出し膜を用いたディスクにおいて微小マークの超解像効果がみられた。

【0374】

3、などの硫化物、SnSe₂、Sb₂Se₃、CdSe、ZnSe、In₂Se₃、Ga₂Se₃、GeSe、GeSe₂、SnSe、PbSeBi₂Se₃等のセレン化物、CeF₃、MgF₂、CaF₂などの弗化物、またはSi、Ge、TiB₂、B₄C、B、C、またはここで述べたすべての保護膜用材料に近い組成のものを用いてもよい。また、アクリル樹脂、ポリカーボネイト、ポリオレフィン、エポキシ樹脂、ポリイミド、ポリスチレン、ポリエチレン、ポリエチレンテレフタレート、ポリ

4フッ化エチレン(テフロン)、などのフッ素樹脂などにより形成することができる。ホットメルト接着剤として知られているエチレン-酢酸ビニル共重合体などや、接着剤などでもよい。これらの樹脂の少なくとも1つを主成分とする紫外線硬化樹脂で形成してもよい。有機物の基板で保護層を兼ねてもよい。あるいは、これらの混合材料層または多重層でもよい。中間層を省略した場合には、超解像読み出し感度が約30%低下し、超解像読み出し可能回数も減少した。中間層の屈折率は、1.7以上2.3以下の範囲で、膜厚は、3nm以上400nm以下の範囲で48dB以上のC/Nが得られた。

【0375】反射層に用いたAl-Tiの代わりにAu, Ag, Cu, Cr, Si, Ge, Al, Ni, Fe, Co, Cr, Ti, Pd, Pt, W, Ta, Mo, Sbの単体、またはこれらを主成分とする合金、化合物、混合物あるいはこれら同志の合金の層、あるいは多重層、これらと酸化物などの他の物質との複合層などを用いてよい。

【0376】基板として表面に直接トラッキングガイド*

膜組成

消衰係数kの変化量

10⁵回超解像読み出し後の再生信号のC/N

(Cr ₄ Tes) ₈₀ (GeSb ₂ Te ₄) ₂₀	△k' = 5%	37dB
(Cr ₄ Tes) ₆₀ (GeSb ₂ Te ₄) ₄₀	△k' = 10%	42dB
(Cr ₄ Tes) ₄₀ (GeSb ₂ Te ₄) ₆₀	△k' = 20%	46dB
(Cr ₄ Tes) ₂₀ (GeSb ₂ Te ₄) ₈₀	△k' = 30%	48dB

この結果より、20%≤△k'の範囲が好ましいことが分かる。

【0380】【実施例9】高融点成分を超解像読み出し膜に入れると、超解像読み出し可能回数が向上した。この時の超解像読み出し膜中の融点の差(Δm. p=高融

*などの凹凸を形成したポリカーボネート基板の代わりに、ポリオレフィン、エポキシ、アクリル樹脂、紫外線硬化樹脂層を表面に形成した化学強化ガラスなどを用いてよい。

【0377】なお、図13に示した超解像読み出し膜を用いたディスクは片面構造であるが、ポリカーボネイト基板11'の代わりに11から15と同じ構造を2つ作製し、接着層6を介して貼り合わせた両面構造としてもよい。

【0378】【実施例8】図1に示したディスクにおいて、超解像読み出し膜の組成を次のように変化させたところ、レーザ光の照射の前後における超解像読み出し膜の消衰係数kの変化量△k'が変化した。これらの超解像読み出し膜を備えたディスクに光スポットの直径の約25%の長さの記録マークを形成し、それを10⁵回超解像読み出した後の再生信号のC/Nを比較したところ、以下に示すような結果が得られた。

【0379】

高融点成分	Δm. p (°C)	超解像読み出し可能回数(回)
Pt ₃ Sb	50	5×10 ⁵
Mo ₃ Sb ₇	150	1×10 ⁶
CoSb ₃	200	2×10 ⁶
Cr ₄ Tes	≥300	≥2×10 ⁶

この結果より、Δm. p≥150の範囲が好ましいことが分かる。

【0382】【実施例10】実施例7に記載した超解像読みだし膜において、GeSb₂Te₄以外の相変化成分としては、下記D群のうち少なくとも一者、もしくはこれに近い組成あるいは、融点650°C以下の化合物、またはそれに近い組成のもの、あるいはこれらの混合組成や混合組成に近い3元以上の化合物のうちの少なくとも一者で置き換えるても同様な結果が得られる。

【0383】<D群>Sn, Pb, Sb, Te, Zn, Cd, Se, In, Ga, S, Tl, Mg, Tl₂Se, TlSe, Tl₂Se₃, Tl₃Te₂, TlTe, InBi, In₂Bi, TeBi, Tl-Se, Tl-

※点成分の融点-相変化成分の融点)による超解像読み出し可能回数の違いを調べた。ここでは相変化成分はGeSb₂Te₄を用いて高融点成分を変化させた。

30 【0381】

Te, Pb-Sn, Bi-Sn, Se-Te, S-S, Bi-Ga, Sn-Zn, Ga-Sn, Ga-I, In₃SeTe₂, AgInTe₂, GeSb₄Te₇, Ge₂Sb₂Te₅, GeSb₂Te₄, GeBi₄Te₇, GeBi₂Te₄, Ge₃Bi₂Te₆, Sn₂Sb₆Se₁₁, Sn₂Sb₂Se₅, SnSb₂Te₄, Pb₂Sb₆Te₁₁, CuAsSe₂, Cu₃AsSe₃, CuSb₂, CuSbSe₂, InSe, Sb₂Se₃, Sb₂Te₃, Bi₂Te₃, SnSb, FeTe, Fe₂Te₃, FeTe₂, ZnSb, Zn₃Sb₂, VTe₂, V₅Te₈, AgIn₂, BiSe, InSb, In₂Te, In₂Te₅, Ba₄Tl, Cd₁₁Nd, Ba₁₃Tl, Cd₆Nd, Ba₂Tl。

【0384】 Cr_4Te_5 以外の高融点成分としては、次の化合物、合金、またはそれに近い組成のもの、あるいはこれらの混合組成や混合組成に近い3元以上の化合物のうちの少なくとも一者で置き換えると同様な結果を得られる。

【0385】(a) 相変化成分の融点が450~650°Cの時

下記A群の化合物、あるいは融点800°C以上の化合物。

【0386】<A群> BaPd_2 , BaPd_5 , NdPd_2 , NdPd_3 , NdPd_5 , Nd_7Pt_3 , Nd_3Pt_2 , NdPt , Nd_3Pt_4 , NdPt_2 , NdPt_5 , Bi_2Nd , BiNd , Bi_3Nd_4 , Bi_3Nd_5 , BiNd_2 , Cd_2Nd , CdNd , Mn_2Nd , $\text{Mn}_{23}\text{Nd}_6$, Mn_{12}Nd , Nd_5Sb_3 , Nd_4Sb_3 , NdSb , NdSb_2 , Fe_2Nd , Fe_7Nd_2 , Cs_3Ge_2 , CsGe , CsGe_4 , Nd_5Si_3 , Nd_5Si_4 , NdSi , Nd_3Si_4 , Nd_2Si_3 , Nd_5Si_9 , Cs_2Te , NdTe_3 , Nd_2Te_5 , NdTe_2 , Nd_4Te_7 , Nd_2Te_3 , Nd_3Te_4 , NdTe , Ce_3Ir , Ce_2Ir , $\text{Ce}_{55}\text{Ir}_{45}$, CeIr_2 , CeIr_3 , Ce_2Ir_7 , CeIr_5 , CaPd , CaPd_2 , CaGe , Ca_2Ge , GeNa_3 , GeNa , CaSi_2 , Ca_2Si , CaSi , Se_2Sr , Se_3Sr_2 , SeSr , GeSr_2 , GeSr , Ge_2Sr , SnSr , Sn_3Sr_5 , SnSr_2 , Ce_2T_1 , Ce_5T_{13} , CeT_{13} , Ce_3T_{15} , CeT_1 , BaT_1 , $\text{Pd}_{13}\text{T}_{19}$, Pd_2T_1 , Pd_3T_1 , Mg_2Si , Mg_2Ge , BaPd_2 , BaPd_5 , Ce_4Se_7 , Ce_3Se_4 , Ce_2Se_3 , CeSe , Ce_5Ge_3 , Ce_4Ge_3 , Ce_5Ge_4 , CeGe , Ce_3Ge_5 , Ce_5Si_3 , Ce_3Si_2 , Ce_5Si_4 , CeSi , Ce_3Si_5 , CeSi_2 , Ce_2T_3 , Ce_5Te_5 , Ce_4Te_2 , Ce_4Te_7 , Ce_3Te_4 , CeTe , La_3Se_7 , La_2Se_2 , La_4Se_7 , La_2Se_3 , La_3Se_4 , LaSe , GeLa_3 , Ge_3La_5 , Ge_4La_5 , GeLa , Ge_5La_3 , BaSe_2 , Ba_2Se_3 , BaSe , PdSe , Mo_3Se_4 , MoSe_2 , Ba_2Ge , BaGe_2 , BaGe , Ba_2Te_3 , BaTe , Ge_2Pd_5 , GePd_2 , $\text{Ge}_9\text{Pd}_{25}$, GePd , Ge_3Pt , Ge_3P_2 , GePt , Ge_2Pt_3 , GePt_2 , GePt_3 , Pu_3Sn , Pu_5Sn_3 , Pu_5Sn_4 , Pu_8Sn_7 , Pu_7Sn_8 , Pu_8Sn_2 , Pu_8Sn_3 , Pt_5Te_4 , Pt_4Te_5 , Pt_2Te_2 , GeNi_1 , Ge_3Ni_5 , Ge_2Ni_5 , GeNi_3 , $\text{NiTe}_{0.85}$, $\text{NiTe}_{0.775}$, $\text{Ni}_{3\pm x}\text{Te}_x$, $\text{Cr}_{11}\text{Ge}_9$, CrGe , $\text{Cr}_{11}\text{Ge}_8$, Cr_5Ge_3 , Cr_3Ge , CrSi_2 , Cr_5Si_3 , Cr_3Si , Cr_5Te_8 , Cr_4Te_5 , Cr_3Te_4 , Cr_{1-x}Te , Ge_3Mn_5 , GeM

Mn_2 , Mn_6Si , Mn_9Si_2 , Mn_3Si , Mn_5Si_2 , Mn_5Si_3 , MnSi , $\text{Mn}_{11}\text{Si}_{19}$, Mn_2Sn , $\text{Mn}_{3.25}\text{Sn}$, MnTe , Te_2W , FeGe_2 , Fe_5Ge_3 , Fe_3Ge , Fe_2Si , Fe_5Si_3 , FeSi , FeSi_2 , Ge_2Mo , $\text{Ge}_{41}\text{Mo}_{23}$, $\text{Ge}_{16}\text{Mo}_9$, $\text{Ge}_{23}\text{Mo}_{13}$, Ge_3Mo_5 , GeMo_3 , Mo_3Si , Mo_5Si_3 , MoSi_2 , MoSn , Mo_2 , Mo_3Te_4 , MoTe_2 , Si_2Ti , SiT_1 , Si_4T_5 , Si_3T_5 , SiTi_3 , Sn_5Ti_6 , Sn_3Ti_5 , Sn_2Ti_2 , Sn_2Ti_3 , CoGe_2 , Co_5Ge_7 , CoGe , Co_5Ge_3 , Co_4Ge , Co_3Te_4 , Ge_7Re_3 , Re_5Si_3 , ReSi , ReSi_2 , Re_2Te 。

【0387】(b) 相変化成分の融点が250~450°Cの時

前記A群または下記B群の化合物、あるいは融点600°C以上の化合物。

【0388】<B群> Cs_3Ge , Ba_2T_1 , GePd_3 , Fe_6Ge_5 , FeTe_2 , Co_5Ge_2 , Nd_3Pd_2 , Cs_3Te_2 , Ce_4Ir , NaPd , Ca_9Pd_2 , Ca_2Ge , Se_3Sr , Ce_3T_1 , CeSe_2 , Ce_3Ge , BaSe_3 , GeSe_2 , GeSe , BaTe_2 , GePd_5 , $\text{Ge}_8\text{Mn}_{11}$, MnTe_2 , Ge_3W_2 , FeGe , Fe_4Ge_3 , Fe_3Sn , Fe_3Sn_2 , FeSn , CoTe_2 。

【0389】(c) 相変化成分の融点が250°C以下の時

前記A群、B群または下記C群の化合物、あるいは融点400°C以上の化合物。

【0390】<C群> Ba_4T_1 , CsTe , Ba_4T_1 , Ba_{13}T_1 , Cd_{11}Nd , Cd_6Nd , Cs_5T_4 , Ca_3Pd_2 , Ca_5Pd_2 , Sn_3Sr , Ba_{13}T_1 , Pd_2T_1 , FeSe_2 , FeSe , Cr_2Te_3 , CrTe_3 , FeSn_2 。

【0391】【実施例1】超解像読み出し膜において、上記高融点成分と上記相変化成分の組合せでは Cr_4Te_5 と $\text{Ge}_3\text{Sb}_2\text{Te}_4$ のように、それぞれの成分に同じ元素が存在する組みあわせが超解像読み出し特性が良好であった。ただし、同じ元素の量が多すぎると両方の成分の融点の差がでなくなるため、同じ元素の量は成分中の80原子%以下が好ましかった。また、量が少ないとアパーチャーパー部分における両成分の屈折率が等しくならない場合が多く、30原子%以上が好ましかった。

【0392】【実施例1】超解像読み出し膜中の相変化成分として $\text{Ge}_3\text{Sb}_2\text{Te}_4$ を、高融点成分として Cr_4Te_5 を用い、高融点成分含有量(原子%)を変化させてC/Nと超解像読み出し可能回数を調べたところ、次のような結果が得られた。

【0393】

5	6×10^5
10	1×10^6
20	2×10^6
≥ 30	$\geq 2 \times 10^6$
高融点成分含有量(%)	C/N(dB)
≤ 30	≥ 4.8
40	4.8
50	4.6
60	4.2

この結果より、高融点成分含有量は10~50%の範囲が好ましく、20~40%の範囲がより好ましいことがわかる。

【0394】高融点成分中で酸化物、硫化物、窒化物、炭化物の含有量は高融点成分の50%未満とするのが好ましく、20%未満とするのが特に好ましい。これらの含有量が多いと相変化成分との複素屈折率の差を小さくできなかつたり、相変化成分中に酸素等が拡散して超解像*20

S _n 75 Z _n 25	250	3
I _n 2 T _e 5	450	6
G _e 2 S _b 2 T _e 5	650	8

超解像読み出し膜の融点が低い方が、超解像読み出し時のパワーが低くて済み、好ましい。

【0397】【実施例14】回転数一定の場合、ディスクの内周と外周では線速が異なる。5インチディスクでは、線速は5.7~11.3m/sまで変化するため、これに対応して内周では20nm、外周では40nmになるように超解像読み出し膜厚を変化させたところ、光スポットのうちマスクされない領域の幅が内周ほど小さくなり、内周、外周の両方において、C/N 4.8 dBという良好な超解像読み出し特性を得た。また、内周から外周に向かってG_eS_bT_e系のG_eS_b2T_e4あるいはG_e2S_b2T_e5組成からのずれ量を少なくしたところ、外周へいくほど結晶化速度が早くなるため、線速対応が容易になり、内周、外周の両方において、C/N 4.8 dBという良好な超解像読み出し特性を得た。

【0398】【実施例15】図14に、超解像読み出し用装置の超解像読み出し系のブロック図を示す。超解像読み出し指令42を受けて、光ヘッド50からレーザ照射が行われ、光ディスク51から戻ってきた反射光を再び光ヘッド50で検出する。

【0399】レーザ光として連続光を用いる場合は図の(a)の系統とし、パルス光を用いる場合にはパルス化回路43を組み込んで(b)の系統とする。パルス光の同期はアドレス部、フラグ部検出45を通して行う。

【0400】良好な超解像読み出し特性を得るために、

*像読み出し特性を劣化させたりする問題を生じやすい。

【0395】【実施例13】超解像読み出し膜材料により、超解像読み出し膜の融点が異なるため、相変化成分の組成を変えて最適超解像読み出しパワーを調べたところ、次のようになった。高融点成分としてはCr₄T_e5を用いた。

【0396】

レーザパワー設定回路47はトラッキング及び自動焦点合わせ用レーザパワーP_tと超解像読み出し用レーザパワーP_rの関係を次式のように保つ。

【0401】P_r/P_t ≥ 2

30 また、超解像読み出し用膜の最高温度となる領域でも膜全体が融解しないで高融点成分は固相に留まるようにするため、レーザパワー照射時には戻り光の反射光強度分布の乱れを光強度分布解析回路48で検出解析し、乱れの大きさに応じてレーザパワーを調節できる回路をレーザパワー設定回路47に組み込んだ。これにより、超解像読み出し用膜の劣化が起りにくくなった。

【0402】ここで、光強度分布の乱れとは、光強度分布の乱れの時間的変動、すなわち各検出器出力の比の時間的変動のことである。光強度分布の乱れは1次元的、

40 または2次元的に配列した2個以上の検出器が記録媒体面にほぼ平行に配置されたものを用い、各検出器の出力を光強度分布解析回路48に接続して検出した。

【0403】超解像読み出し用膜の劣化を防ぐため、超解像読み出しレーザ光をパルス光とした。このとき、レーザスポット径(λ/NA)とアーチャーのトラック方向の中心部の長さaの比(a:λ/NA)を1/3~1/2にでき、微小マークを持つディスクで、0.4λ/NA ≤ vTの範囲ではスポットが30%以上重なるため、パルス化の効果が少なく、vT ≤ 1.5λ/NAの範囲ではマークを読み飛ばしてしまうことがわかった。

【0404】そこで、マークの超解像読み出しを確実に行うため、下式を満たすための回路を、図14のパルス化回路43に組み込んだ。

【0405】 $0.4\lambda/NA \leq vT \leq 1.5\lambda/NA$
 $0.3k \leq x/T \leq 0.5k$

その結果、C/N 4.6 dBを得ることができた。kは比例定数で、図7の構造のディスクにおいてレーザパワー8mW、線速8m/sの時、k=1であった。さらに、下式を満たすと、C/Nが2dB向上した。

【0406】 $0.5\lambda/NA \leq vT \leq 0.9\lambda/NA$
 $0.3k \leq x/T \leq 0.5k$

【実施例16】図9は、本発明の超解像読み出し膜を用いた読み書き可能ディスクの構造断面図の一例を示したものである。本実施例では、前記一般式(8)の平均組成を有する超解像読み出し膜を用いた。

【0407】まず、直径13cm、厚さ1.2mmのポリカーボネイト基板を形成した。次に、この基板を複数のターゲットを備え順次積層膜を形成でき、また、膜厚の均一性、再現性のよいマグネットロンスパッタリング装置内に取付け、この上に厚さ125nmの(ZnS)₈₀(SiO₂)₂₀層を形成した。続いて、(Sn₃Zn)₈₀(SnTi₂)₂₀膜を30nm、(ZnS)₈₀(SiO₂)₂₀層、(Cr₄Te₅)₂₀(GeSb₂Te₄)₈₀*

組成	超解像読み出し可能回数
Sn ₅₅ Zn ₂₀ Ti ₂₅	>2×10 ⁶ 回
Sn ₆₇ Zn ₂₀ Ti ₁₃	2×10 ⁶ 回
Sn ₇₅ Zn ₂₀ Ti ₅	1×10 ⁶ 回
Sn ₈₀ Zn ₂₀	5×10 ⁵ 回
組成	10 ⁵ 回超解像読み出し後の再生信号のC/N
Sn ₂₅ Zn ₂₀ Ti ₅₅	44dB
Sn ₃₀ Zn ₂₀ Ti ₅₀	46dB
Sn ₄₀ Zn ₂₀ Ti ₄₀	48dB
Sn ₅₅ Zn ₂₀ Ti ₂₅	50dB
Ti含有量	10 ⁵ 回超解像読み出し後の再生信号のC/N
g=0%	46dB
g=10%	48dB
g=20%	46dB
g=25%	43dB
これより、前記一般式(8)におけるe, fの範囲は3.0≤e≤9.5, 5≤f≤50が好ましく、4.0≤e≤8.7, 1.3≤f≤4.0がより好ましいことがわかる。	ZnのようにD, D'2元素の場合)、E, Fの組合せにおいて、D-E, E-F, D'-Eの組合せからできる高融点成分が共晶点をもたないか、共晶点をもつてもD, D-D'の融点より150°C以上融点が高いの
【0412】さらに、前記の(Sn ₃ Zn) ₈₀ (SnTi ₂) ₂₀ よりなる超解像読み出し膜26において、Sn含有量	【0413】

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が好ましかった。

【0415】〔実施例18〕前記実施例16のSn-Zn-Tiよりなる超解像読み出し膜を、前記一般式(8)で表される平均組成の材料、Pb-Se, Pb-Ce, Pb-La, Pb-Pt, Pb-Si, Sn-Sb, Sn-Se, Sn-Co, Sn-Cu, Sn-Ni, Sn-Pt, Bi-Te, Bi-Se, Bi-Ce, Bi-Cu, Bi-Cd, Bi-Pt, Zn-Ni, Zn-Pt, Zn-La, Zn-Ce, Ga-Cr, Ga-Cu, Ga-Ni, Ga-La, Ga-Pt, Ga-Ce, In-Se, In-Sb, In-Te, In-As, In-Mn, In-Ni, In-Ag, Pb-Sn-Se, Pb-Sn-Ce, Pb-Sn-La, Pb-Sn-Pt, Pb-Sn-Si, Pb-Sn-Sb, Pb-Sn-Co, Pb-Sn-Cu, Pb-Sn-Ni, Sn-Bi-Sb, Sn-Bi-Se, Sn-Bi-Co, Sn-Bi-Cu, Sn-Bi-Ni, Sn-Bi-Pt, Sn-Bi-Te, Sn-Bi-Ce, Sn-Bi-Cd, Zn-Sn-Sb, Zn-Sn-Se, Zn-Sn-Co, Zn-Sn-Cu, Zn-Sn-Ni, Zn-Sn-Pt, Zn-Sn-Ni, Zn-Sn-La, Zn-Sn-Ce, Sn-Ga-Sb, Sn-Ga-Se, Sn-Ga-Co, Sb-Ga-Cu, Sn-Ga-Ni, Sn-Ga-Pt, Sn-Ga-Cr, Sn-Ga-La, Sn-Ga-Ce, Bi-Ga-Te, Bi-Ga-Se, Bi-Ga-Cu, Bi-Ga-Cd, Bi-Ga-Pt, Bi-Ga-Cr, Bi-Ga-Ni, Bi-Ga-La, Bi-Ga-Ce, In-Ga-Cr, In-Ga-Cu, In-Ga-Ni, In-Ga-La, In-Ga-Pt, In-Ga-Ce, In-Ga-Se, In-Ga-Sb, In-Ga-Te, In-Ga-Ag, In-Ga-Mn, In-Ga-Ag, In-Bi-Te, In-Bi-Se, In-Bi-Cu, In-Bi-Cd, In-Bi-Pt, In-Bi-Sb, In-Bi-As, In-Bi-Mn, In-Bi-Ni, In-Bi-Ag, In-Bi-Ce, などに変更しても同様の結果が得られた。

【0416】〔実施例19〕前記実施例16の(Sn₃Zn)₈₀(SnTi₂)₂₀よりなる超解像読み出し膜を、前記一般式(11)で表される平均組成の材料、例えばSe₅₁In₄₀Cr₉ (高融点成分Cr₃Se₄、相変化成分; InSe) などに変更しても同様の結果が得られる。ただし、読み出し可能回数が2×10⁶回以上、10⁵回超解像読み出し後の再生信号のC/Nが46dB以上となる前記一般式(11)中のp, q, r, sの範囲は、4.0≤p≤9.5、0≤q≤5.5、5≤r≤5.0、0≤s≤2.0であった。C/Nが4.8dB以上となるより好ましい範囲は、5.0≤p≤8.0、0≤q≤4.0、1.0≤r≤4.0、0≤s≤1.0であった。また、こ

の組成は、相変化記録膜28としても使用できた。超解像読み出し膜を用いない記録媒体の相変化記録膜としても使用できる。

【0417】〔実施例20〕前記実施例19のSe-In-Crよりなる超解像読み出し膜を、前記一般式(2)で表される平均組成の材料、Se-In-Si, Se-In-Ag, Se-In-Al, Se-In-Ba, Se-In-Ca, Se-In-Cd, Se-In-Co, Se-In-Cu, Se-In-Mg, Se-In-Mn, Se-In-Mo, Se-In-Ni, Se-In-Pd, Se-In-Pt, Se-In-Ta, Se-In-Ti, Se-In-V, Se-In-W, Se-In-Y, Se-In-Pb, Se-Sb-Si, Se-Sb-Ag, Se-Sb-Al, Se-Sb-Ba, Se-Sb-Ca, Se-Sb-Cd, Se-Sb-Co, Se-Sb-Cr, Se-Sb-Cu, Se-Sb-Mg, Se-Sb-Mn, Se-Sb-Mo, Se-Sb-Ni, Se-Sb-Pd, Se-Sb-Pt, Se-Sb-Ta, Se-Sb-Ti, Se-Sb-V, Se-Sb-W, Se-Sb-Y, Se-Sb-Pb, Se-Bi-Si, Se-Bi-Ag, Se-Bi-Al, Se-Bi-Ba, Se-Bi-Ca, Se-Bi-Cd, Se-Bi-Co, Se-Bi-Cr, Se-Bi-Cu, Se-Bi-Mg, Se-Bi-Mn, Se-Bi-Mo, Se-Bi-Ni, Se-Bi-Pd, Se-Bi-Pt, Se-Bi-Ta, Se-Bi-Ti, Se-Bi-V, Se-Bi-W, Se-Bi-Y, Se-Bi-Pb, Se-Te-Si, Se-Te-Ag, Se-Te-Al, Se-Te-Ba, Se-Te-Ca, Se-Te-Cd, Se-Te-Co, Se-Te-Cr, Se-Te-Cu, Se-Te-Mg, Se-Te-Mn, Se-Te-Mo, Se-Te-Ni, Se-Te-Pd, Se-Te-Pt, Se-Te-Ta, Se-Te-Ti, Se-Te-V, Se-Te-W, Se-Te-Y, Se-Te-Pb, Se-Au-Si, Se-Au-Ag, Se-Au-Al, Se-Au-Ba, Se-Au-Ca, Se-Au-Cd, Se-Au-Co, Se-Au-Cr, Se-Au-Cu, Se-Au-Mg, Se-Au-Mn, Se-Au-Mo, Se-Au-Ni, Se-Au-Pd, Se-Au-Pt, Se-Au-Ta, Se-Au-Ti, Se-Au-V, Se-Au-W, Se-Au-Y, Se-Au-Pb, Se-B-Si, Se-B-Ag, Se-B-Al, Se-B-Ba, Se-B-Ca, Se-B-Cd, Se-B-Co, Se-B-Cr, Se-B-Cu, Se-B-Mg, Se-B-Mn, Se-B-Mo, Se-B-Ni, Se-B-Pd, Se-B-Pt, Se-B-Ta, Se-B-Ti, Se-B-V, Se-B-W, Se-B-Y, Se-B-Pb, Se-Cs-Si, Se-Cs-Ag, S

e-Cs-Al, Se-Cs-Ba, Se-Cs-Ca, Se-Cs-Cd, Se-Cs-Co, Se-Cs-Cr, Se-Cs-Cu, Se-Cs-Mg, Se-Cs-Mn, Se-Cs-Mo, Se-Cs-Ni, Se-Cs-Pd, Se-Cs-Pt, Se-Cs-Ta, Se-Cs-Ti, Se-Cs-V, Se-Cs-W, Se-Cs-Y, Se-Cs-Pb, Se-Sn-Si, Se-Sn-Ag, Se-Sn-Al, Se-Sn-Ba, Se-Sn-Ca, Se-Sn-Cd, Se-Sn-Co, Se-Sn-Cr, Se-Sn-Cu, Se-Sn-Mg, Se-Sn-Mn, Se-Sn-Mo, Se-Sn-Ni, Se-Sn-Pd, Se-Sn-Pt, Se-Sn-Ta, Se-Sn-Ti, Se-Sn-V, Se-Sn-W, Se-Sn-Y, Se-Sn-Pb, Se-T1-Si, Se-T1-Ag, Se-T1-Al, Se-T1-Ba, Se-T1-Ca, Se-T1-Cd, Se-T1-Co, Se-T1-Cr, Se-T1-Cu, Se-T1-Mg, Se-T1-Mn, Se-T1-Mo, Se-T1-Ni, Se-T1-Pd, Se-T1-Pt, Se-T1-Ta, Se-T1-Ti, Se-T1-V, Se-T1-W, Se-T1-Y, Se-T1-Pb, Se-S-Si, Se-S-Ag, Se-S-Al, Se-S-Ba, Se-S-Ca, Se-S-Cd, Se-S-Co, Se-S-Cr, Se-S-Cu, Se-S-Mg, Se-S-Mn, Se-S-Mo, Se-S-Ni, Se-S-Pd, Se-S-Pt, Se-S-Ta, Se-S-Ti, Se-S-V, Se-S-W, Se-S-Y, Se-S-Pb, Se-Ge-Si, Se-Ge-Ag, Se-Ge-Al, Se-Ge-Ba, Se-Ge-Ca, Se-Ge-Cd, Se-Ge-Co, Se-Ge-Cr, Se-Ge-Cu, Se-Ge-Mg, Se-Ge-Mn, Se-Ge-Mo, Se-Ge-Ni, Se-Ge-Pd, Se-Ge-Pt, Se-Ge-Ta, Se-Ge-Ti, Se-Ge-V, Se-Ge-W, Se-Ge-Y, Se-Ge-Pb, Se-Fe-Si, Se-Fe-Ag, Se-Fe-Al, Se-Fe-Ba, Se-Fe-Ca, Se-Fe-Cd, Se-Fe-Co, Se-Fe-Cr, Se-Fe-Cu, Se-Fe-Mg, Se-Fe-Mn, Se-Fe-Mo, Se-Fe-Ni, Se-Fe-Pd, Se-Fe-Pt, Se-Fe-Ta, Se-Fe-Ti, Se-Fe-V, Se-Fe-W, Se-Fe-Y, Se-Fe-Pb, Se-Zn-Si, Se-Zn-Ag, Se-Zn-Al, Se-Zn-Ba, Se-Zn-Ca, Se-Zn-Cd, Se-Zn-Co, Se-Zn-Cr, Se-Zn-Cu, Se-Zn-Mg, Se-Zn-Mn, Se-Zn-Mo, Se-Zn-Ni, Se-Zn-Pd, Se-Zn-Pt, Se-Zn-Ta, Se-Zn-Ti, Se-Zn-V, Se-Zn-W, S

e-Zn-Y, Se-Zn-Pb, などに変更しても同様の結果が得られた。

【0418】【実施例21】図7は、基板の表面に凹凸のビットで情報が刻まれた再生専用のディスク状情報記録媒体の断面を示す。

【0419】このディスク状媒体は、基板の表面にビットが形成されていること、および記録膜をマスク層13, 13' として用いた点が、実施例1のディスク状媒体と異なっているのみであり、他の構成は同じである。

【0420】すなわち、表面に情報ビットを有するポリカーボネート基板11, 11' の上に、膜厚約125nmの(ZnS)₈₀(SiO₂)₂₀膜よりなる保護層12, 12' がそれぞれ形成され、保護層12, 12' の上には順に、平均膜厚3nmの島状のAg₂Te膜(図示せず)と、膜厚約30nmの((Ag₂Te)₃₀(Se₈₀-Te₂₀)₇₀すなわちAg₂₀Te₂₄Se₅₆の組成のマスク層13, 13' と、膜厚約25nmの(ZnS)₈₀(SiO₂)₂₀膜よりなる中間層14, 14' と、膜厚80nmのAl₉₇Ti₃膜よりなる反射層15, 15' が、それぞれ形成されている。反射層15, 15' 同士は、塩化ビニル・酢酸ビニル系ホットメルト接着剤層16によって貼り合わされている。読み出し用のレーザ光は、基板側から入射される。マスク層13, 13' の中には、実施例1と同様の形態(図1参照)で高融点成分Ag₂Teが析出しており、その残成分(図1における相変化成分3aに相当するもの)は(Se₈₀-Te₂₀)である。

【0421】(高融点成分の他の例)マスク層13, 13' 中に析出した高融点成分としては、Ag₂Te以外に、実施例1および3で述べたものを用いることができる。島状のAg₂Te膜の形成は省略してもよい。

【0422】(高融点成分分析出後の残成分の他の例)高融点成分以外の残成分であるSe₈₀-Te₂₀の一部または全部をSn, Pb, Sb, Bi, Te, Zn, Cd, Se, In, Ga, S, Tl, Mg, Tl₂Se, TlSe, Tl₂Se₃, Tl₃Te₂, TlTe, InBi, In₂Bi, TeBi, Tl-Se, Tl-Te, Pb-Sn, Bi-Sn, Se-Te, S-Se, Bi-Ga, Sn-Zn, Ga-Sn, Ga-In, In₃Se₂, AgInTe₂, GeSb₄Te₇, Ge₂Sb₂Te₅, GeSb₂Te₄, GeB₄Te₇, GeBi₂Te₄, Ge₃Bi₂Te₆, Sn₂Sb₆Se₁₁, Sn₂Sb₂Se₅, SnSb₂Te₄, Pb₂Sb₆Te₁₁, CuAs₂, Cu₃As₂Se₃, CuSb₂, CuSb₂Se₂, InSe, Sb₂Se₃, Sb₂Te₃, Bi₂Te₃, SnSb, FeTe, Fe₂Te₃, FeTe₂, ZnSb, Zn₃Sb₂, VTe₂, V₅Te₈, AgIn₂, BiSe, InSb, In₂Te, In₂Te₅のうちの少なくとも一者を主成分とする材料、あるいはそれに近い組成の材料で置き換えて、近い特性が得られる。

【0423】この残成分は、融点が650°C以下である金属、化合物または合金が好ましい。

【0424】また、超解像読みだしにおいて、各層の膜厚を変えれば、図14とは逆に光スポット内の斜線部以外の領域だけをマスクすることもできる。

【0425】残成分の融点が250°C以下の場合、高融点成分の融点は450°C以上であれば、これに近い*

10⁵回読み出し後の再生信号のC/N

△k' = 5%	37 dB
△k' = 10%	42 dB
△k' = 20%	46 dB
△k' = 30%	48 dB

この結果より、20%≤△k'の範囲が好ましいことが分かった。

【0428】高融点成分の析出後の残成分の融点(m.p.)が変化した場合、10⁵回読み出した後の再生信号のC/Nは、次のように変化した。

【0429】

10⁵回読み出しの後の再生信号のC/N

m.p. = 100°C	49 dB
m.p. = 250°C	48 dB
m.p. = 400°C	47 dB
m.p. = 650°C	46 dB
m.p. = 700°C	40 dB
m.p. = 750°C	33 dB

この結果より、高融点成分析出後の残成分の融点は、650°C以下が好ましく、250°C以下がより好ましいことが分かった。

【0430】【実施例22】図9は、実施例1の相変化型の情報記録媒体に実施例4と同様のマスク層を設けることによって、情報の再生時に「超解像効果」を利用できるようにした情報記録媒体の一例である。

【0431】このディスク状媒体は、記録膜の構成が異なる以外は実施例1の情報記録媒体と同じ構成を持つ。すなわち、実施例1と同様のポリカーボネート基板1, 1'の上に、(ZnS)₈₀(SiO₂)₂₀膜よりなる保護層2, 2'がそれぞれ形成され、保護層2, 2'の上には順に、記録膜3, 3'と(ZnS)₈₀(SiO₂)₂₀膜よりなる中間層4, 4'とAl₂Ti₃膜よりなる反射層5, 5'とが、それぞれ形成されている。反射層5, 5'同士は、接着剤層6によって貼り合わされている。

【0432】記録膜3'は、基板1'側から順に配置されたマスク層、誘電体層および記録層から構成されている。記録膜3も記録膜3'と同じ構成である。

【0433】マスク層は、実施例21と同じ((Ag₂Ti₃)₃₀(Se₈₀-Te₂₀)₇₀すなわちAg₂₀Ti₂₄Se₅₆)の組成を持ち、実施例21と同じマスク機能を有している。誘電体層は(ZnS)₈₀(SiO₂)₂₀膜により形成されている。記録層としては、実施例1の記録膜

*特性が得られる。

【0426】光スポット31の直径の約25%の長さの記録マークが形成されている場合、レーザ光の照射の前後におけるマスク層13, 13'の消衰係数kの変化量△k'が変化すると、10⁵回読み出した後の再生信号のC/Nは、次のように変化した。

【0427】

10⁵回読み出し後の再生信号のC/N

△k' = 5%	37 dB
△k' = 10%	42 dB
△k' = 20%	46 dB
△k' = 30%	48 dB

3, 3'と同じものの他、任意の相変化型の記録層を使用できる。

【0434】長さ0.4μmの記録マークを0.8μm周期で形成した場合、得られた再生信号のC/Nは46dB以上、消去比は25dB以上であった。

【0435】このマスク層は、この発明の情報記録用薄膜以外の従来の相変化によって記録を行な情報記録媒体20や、光磁気ディスクなどの相変化以外の記録原理による情報記録媒体においても同様な効果を持つ。

【0436】この実施例で述べていない点については、実施例1と同様である。

【0437】【実施例23】この実施例のディスク状情報記録媒体は、図示していないが、実施例1の図3に示したのとほぼ同じ構成であり、実施例1のAl-Ti反射層1, 1'に代えて、記録膜3, 3'のような高融点成分を含む層を反射層として用いている点のみが異なる。

【0438】反射層中の高融点成分については、実施例1と同様である。

【0439】反射層中の高融点成分が析出した後の残成分については、融点が650°C以下である金属、化合物または合金が好ましく、且つ、複素屈折率の実数部nまたは虚数部(消衰係数)kがレーザ光の照射によって20%以上変化し、また実数部nおよび虚数部kが高いときに反射率Rが60%以上となるのが好ましい。

【0440】反射層として、膜厚80nmの(LaBi)₃₀B₇₀層を用いた場合、読み出し時の超解像効果が得られ、長さ0.4μmの記録マークを0.8μm周期で書いた場合、得られた再生信号のC/Nは46dB以上、消去比は25dB以上であった。なお、(LaBi)₃₀B₇₀層では、高融点成分はLaBiであり、相変化成分はBiである。

【0441】超解像効果が得られる原理は、次の通りである。図8に示すように、光スポット31内の高温領域35では、反射層中の少なくとも相変化成分Biが融解して、複素屈折率の実数部nまたは虚数部kの少なくとも一方が低下するため、図8のマスクとして働く範囲33での反射光が弱くなる。このため、範囲33からの反

射光は、記録膜に対して読み取りのための充分なコントラストを提供できなくなる。

【0442】一方、結晶化した固体状態の低温領域では、高温領域に比べて複素屈折率の実数部nまたは虚数部kの少なくとも一方が大きいため、読み取りのための充分なコントラストを提供できる。

【0443】その結果、検出範囲34が図8のような三日月形になり、光スポット31の直径以下の周期で高密度記録された記録マーク32を確実に読み出すことが可能となる。

【0444】各層の膜厚を変えれば、検出範囲34の大きさを変えることもできる。

【0445】(残成分の他の例) 高融点成分LaBiの残成分であるBiの一部または全部をSn, Pb, Sb, Te, Zn, Cd, Se, In, Ga, S, Tl, Mg, Tl₂Se, TlSe, Tl₂Se₃, Tl₃Te₂, TlTe, InBi, In₂Bi, TeBi, Tl-Se, Tl-Te, Pb-Sn, Bi-Sn, Se-Te, S-Se, Bi-Ga, Sn-Zn, Ga-Sn, Ga-In, In₃SeTe₂, AgInTe₂, GeSb₄Te₇, Ge₂Sb₂Te₅, GeSb₂Te₄, GeBi₄Te₇, GeBi₂Te₄, Ge₃Bi₂Te₆, Sn₂Sb₆Se₁₁, Sn₂Sb₂Se₅, SnSb₂Te₄, Pb₂Sb₆Te₁₁, CuAsSe₂, Cu₃AsSe₃, CuSbS₂, CuSbSe₂, InSe, Sb₂Se₃, Sb₂Te₃, Bi₂Te₃, SnSb, FeTe, Fe₂Te₃, FeTe₂, ZnSb, Zn₃Sb₂, VT₂, V₅Te₈, AgIn₂, BiSe, InSb, In₂Te, In₂Te₅, などのうちの少なくとも一つを主成分とする材料で置き換える、近い特性が得られる。

【0446】残成分の融点が350°C以下の場合、高融点化合物の融点は450°C以上であれば、前記の場合に近い特性が得られる。

【0447】(その他) この実施例の反射層は、本発明の記録用薄膜を用いない従来の相変化によって記録を行なう光記録媒体や、光磁気記録媒体などの他の記録原理による媒体にも適用可能である。

【0448】ここで述べていない事項については、実施例1と同様である。

【0449】

【発明の効果】以上説明したように、この発明の情報記録用薄膜および情報記録媒体によれば、良好な記録・再生特性を保持しながら、従来より多数回の書き換えが可能となる。

【0450】この発明の情報記録用薄膜の製造方法によれば、この発明の情報記録用薄膜および情報記録媒体が

容易に得られる。

【0451】以上説明したように、本発明によれば、多数回の超解像読み出しが可能であり、超解像読み出し特性がよい超解像読み出し用薄膜、情報記録媒体及び超解像読み出し装置を得ることができる。

【図面の簡単な説明】

【図1】この発明の情報記録媒体の実施例の記録用薄膜の部分断面図で、(a)は粒状の高融点成分が析出したもの、(b)は柱状の高融点成分が析出したもの、(c)は多孔質の高融点成分が析出したものを示す。

【図2】この発明の情報記録媒体の実施例の部分断面図で、(a)は(b)のD-D線に沿った断面図、(b)はその情報記録媒体の部分断面図である。

【図3】この発明の情報記録媒体の実施例の全体断面図である。

【図4】記録用薄膜中に析出した高融点成分の寸法の測定法を説明する部分断面図で、(a)は粒状の高融点成分について、(b) (c)は柱状の高融点成分について示している。

20 【図5】この発明の情報記録媒体の実施例を示す、図2(a)と同様の部分断面図である。

【図6】この発明の情報記録用薄膜の記録層の実施例の三角相図である。

【図7】この発明の情報記録媒体の他の実施例の全体断面図である。

【図8】超解像効果の原理を説明するための図である。

【図9】この発明の情報記録媒体のさらに他の実施例の全体断面図である。

30 【図10】この発明の情報記録用薄膜の記録層の実施例4の三角相図である。

【図11】この発明の情報記録用薄膜の記録層の実施例5の三角相図である。

【図12】本発明による超解像読み出しディスクの断面構造の一例を示す図。

【図13】超解像読み出し膜の膜厚と反射率の関係を示す図。

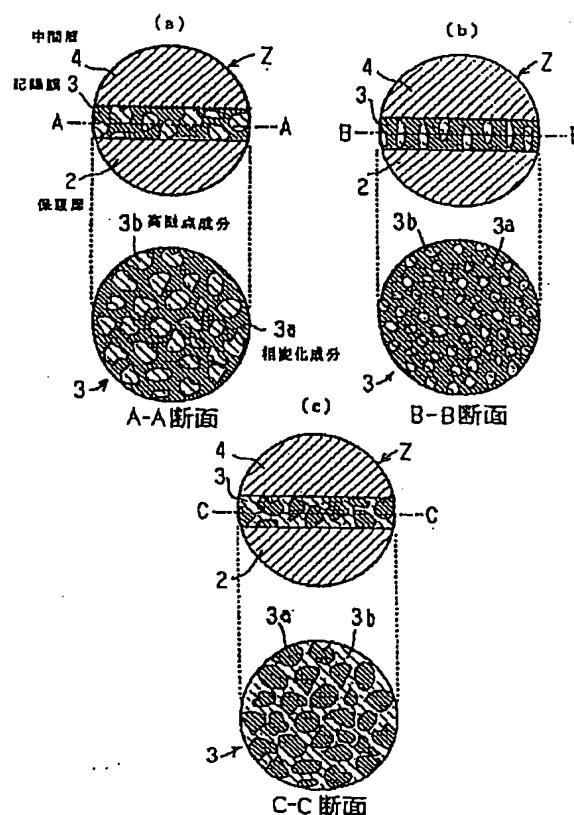
【図14】超解像読み出し装置のブロック図。

【符号の説明】

1, 1'…基板、2, 2'…保護層、3, 3'…記録膜、3a…相変化成分、3b…高融点成分、4, 4'…中間層、5, 5'…反射層、6…接着剤層、11, 11'…基板、12, 12'…保護層、13, 13'…記録膜、14, 14'…中間層、15, 15'…反射層、16…接着剤層、32a, 32b…記録マーク、33…マスクとして働く範囲、34…検出範囲、35…高温領域。

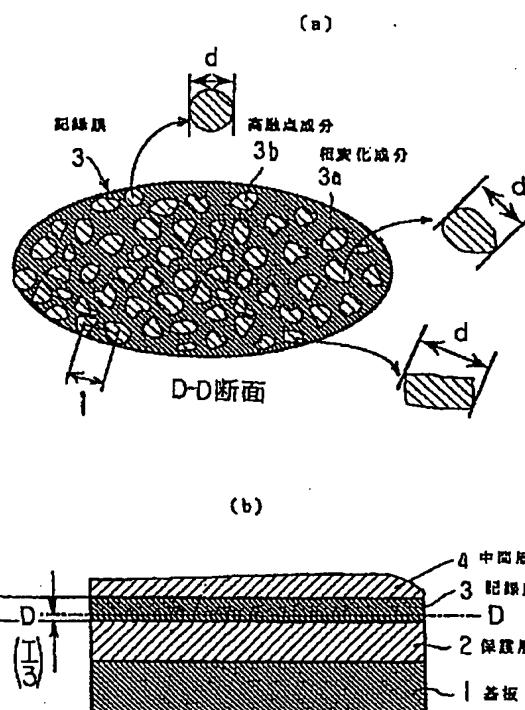
【図1】

図1



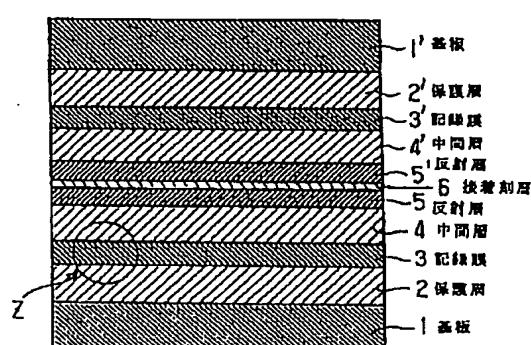
【図2】

図2



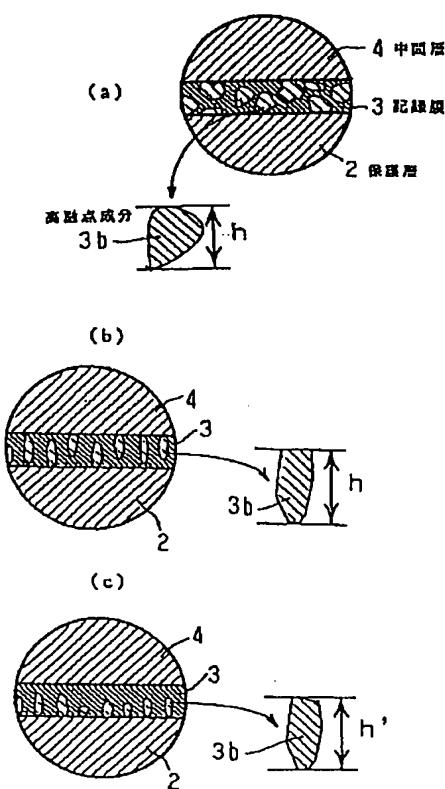
【図3】

図3

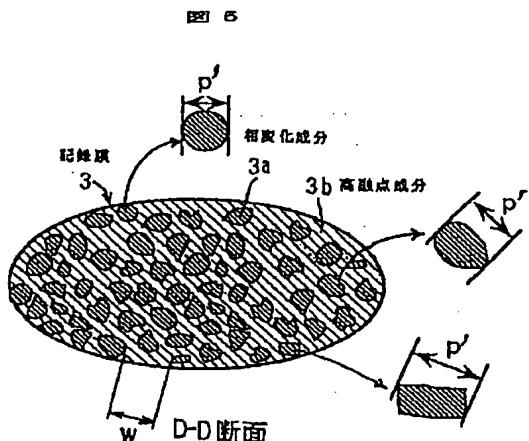


【図4】

図4



【図5】



【図7】

【図6】

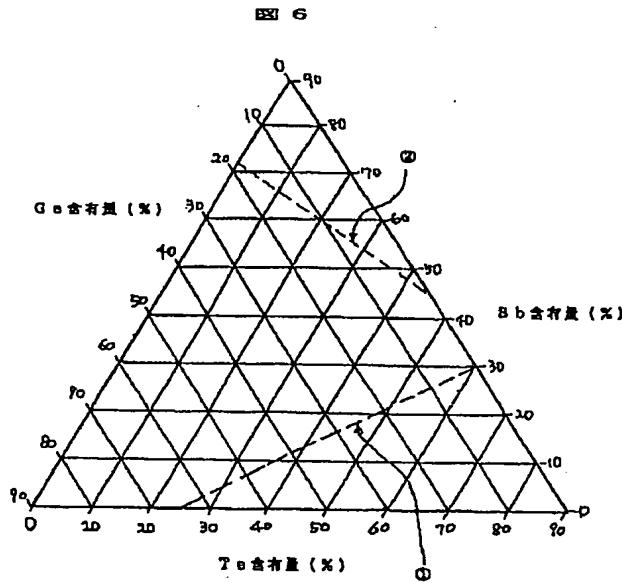
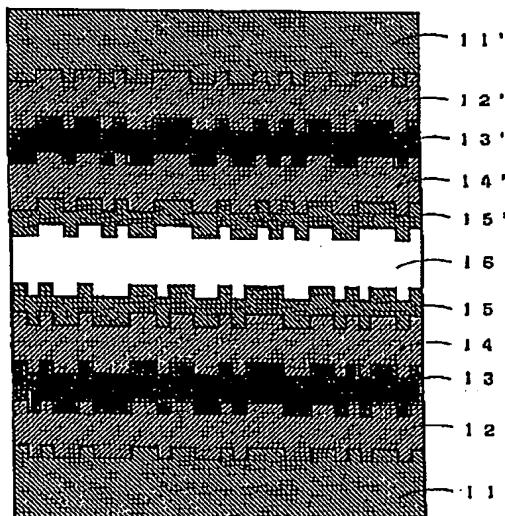
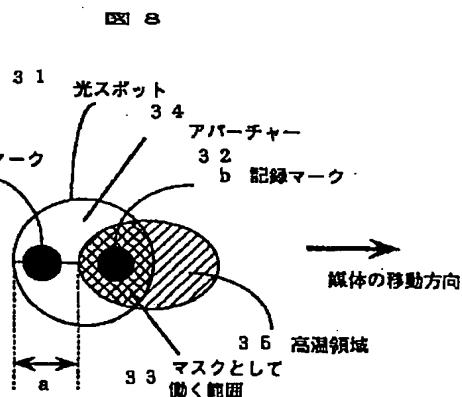


図7



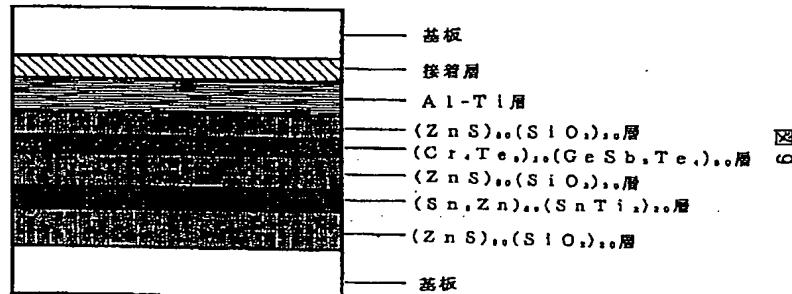
【図8】



超解像読みだしの原理図

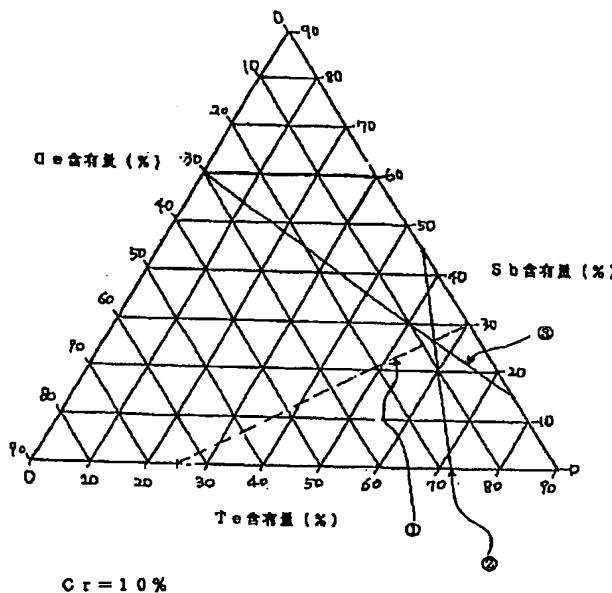
- 11, 11' : 基板
- 12, 12' : 保護層
- 13, 13' : マスク層
- 14, 14' : 中間層
- 15, 15' : 反射層
- 16 : 粘着剤層

【図9】



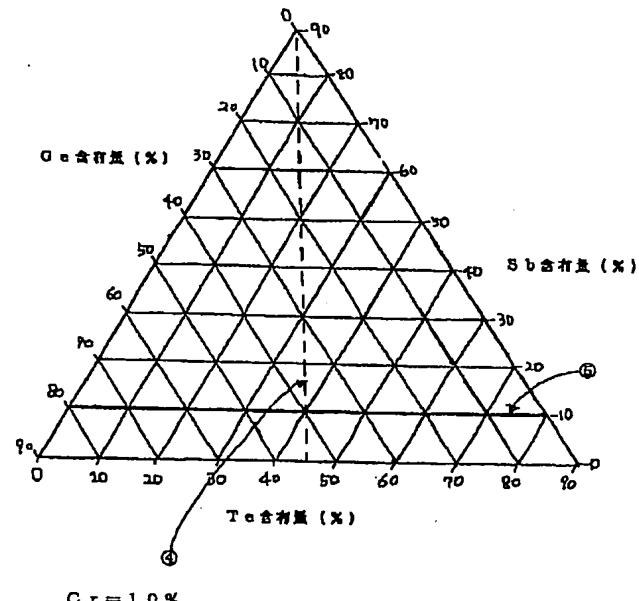
【図10】

図10



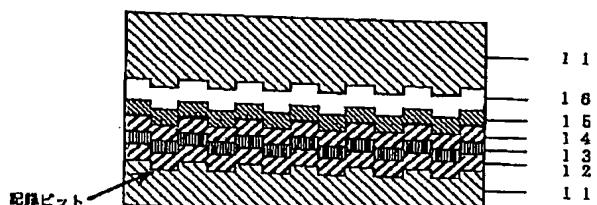
【図11】

図11



【図12】

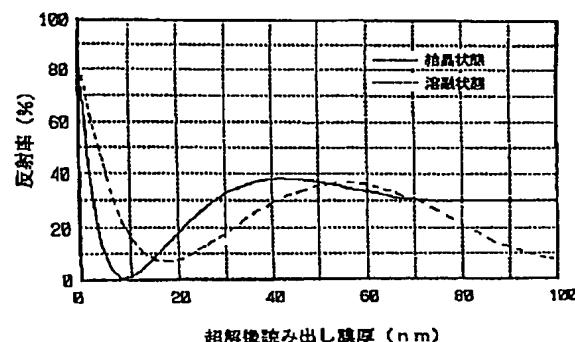
図12



超解像読みだし用ディスクの断面構造

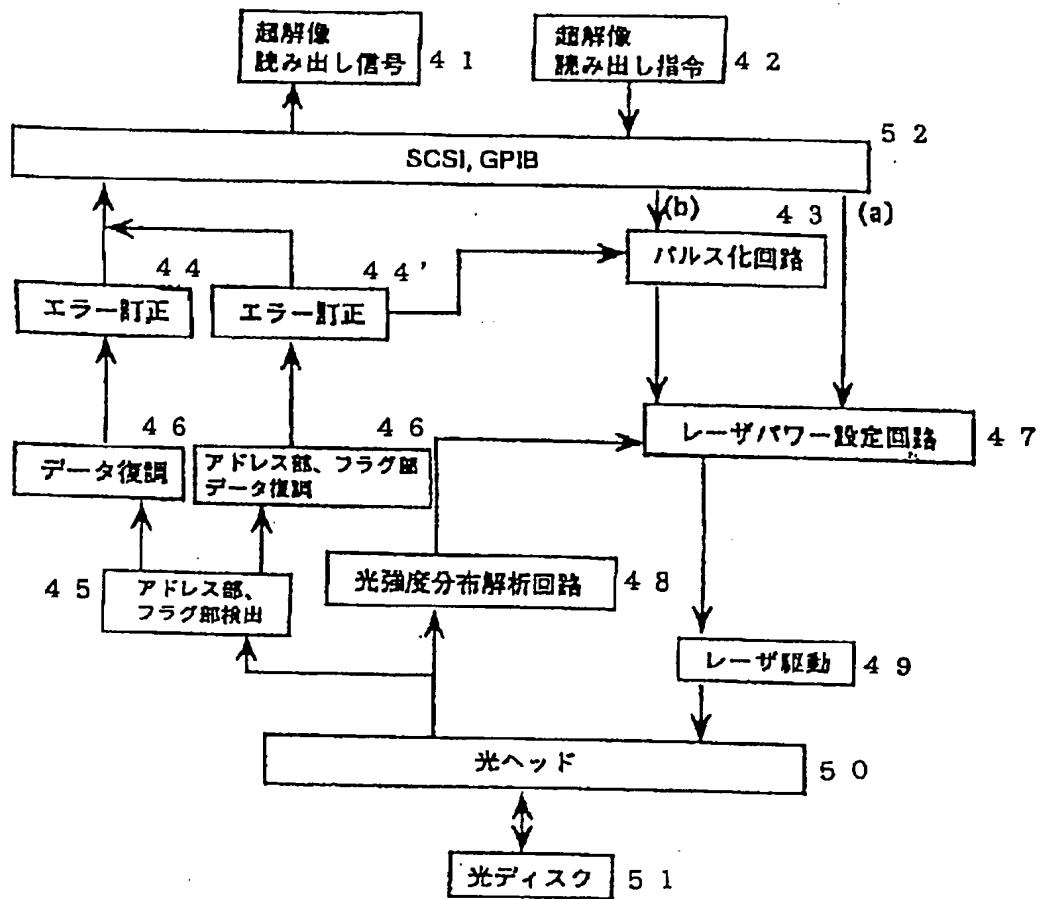
【図13】

図13



【図14】

図14



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【手続補正書】

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【手続補正1】

【補正対象書類名】明細書

【補正対象項目名】発明の名称

【補正方法】変更

【補正内容】

【発明の名称】情報記録媒体、超解像読み出し用装置及び情報記録用媒体の製造方法

【手続補正2】

【補正対象書類名】明細書

【補正対象項目名】特許請求の範囲

【補正方法】変更

【補正内容】

【特許請求の範囲】

【請求項1】基板上に直接または保護層を介して形成された、エネルギービームの照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用薄膜を有する情報記録媒体において、前記情報記録用薄膜の膜厚方向の平均組成が、一般式

$S_{b_x} T_{e_y} A_p B_q C_r$

で表わされ、

前記AはGeおよびInからなる第1群から選ばれた少なくとも一つの元素、前記Bはランタノイド元素およびAg, Ba, Co, Cr, Ni, Pt, Si, Sr, Au, Cd, Cu, Li, Mo, Mn, Zn, Al, Fe, Pb, Na, Cs, Ga, Pd, Bi, Sn, TiおよびVからなる第2群から選ばれた少なくとも一つの

元素、前記CはSb, Teおよび前記AおよびBで表わされる元素以外の少なくとも一つの元素を表わし、前記x, y, p, qおよびrの単位はいずれも原子ペーセントで、それぞれ $2 \leq x \leq 41$, $25 \leq y \leq 75$, $0.1 \leq p \leq 60$, $3 \leq q \leq 40$, $0.1 \leq r \leq 30$ の範囲にあり、

当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、当該薄膜の平均組成を、元素単体または化合物組成の低融点成分Lと元素単体または化合物組成の高融点成分Hにより

$L_j H_k$

の式で表した時、 $20 \leq k / (j + k) \leq 40$ である組成を基準組成とし、上記情報記録用薄膜を構成する各元素の膜中での含有量は前記式で決まる値±10原子%の範囲内にある情報記録用薄膜を有することを特徴とする情報記録媒体。

【請求項2】基板上に直接または保護層を介して形成された、エネルギービームの照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用薄膜を有する情報記録媒体において、

前記情報記録用薄膜の膜厚方向の平均組成が、一般式

$S_{b_x} T_{e_y} A_p B_q$

で表わされ、

前記AはGeおよびInからなる第1群から選ばれた少なくとも一つの元素、前記Bはランタノイド元素およびAg, Ba, Co, Cr, Ni, Pt, Si, Sr, Au, Cd, Cu, Li, Mo, Mn, Zn, Al, Fe, Pb, Na, Cs, Ga, Pd, Bi, Sn, Ti

およびVからなる第2群から選ばれた少なくとも一つの元素を表わし、

前記x, y, pおよびqの単位はいずれも原子パーセントで、それぞれ $2 \leq x \leq 41$, $25 \leq y \leq 75$, $0.1 \leq p \leq 60$, $3 \leq q \leq 40$ の範囲にあり、

当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、当該薄膜の平均組成を、元素単体または化合物組成の低融点成分Lと元素単体または化合物組成の高融点成分Hにより

$L_j H_k$

の式で表した時、 $20 \leq k / (j + k) \leq 40$ である組成を基準組成とし、上記情報記録用薄膜を構成する各元素の膜中での含有量は前記式で決まる値±10原子%の範囲内にある情報記録用薄膜を有することを特徴とする情報記録媒体。

【請求項3】 基板上に直接または保護層を介して形成された、エネルギーービームの照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用薄膜を有する情報記録媒体において、前記情報記録用薄膜の膜厚方向の平均組成が、一般式

$(G_e a S_b b T_e c)_{1-d} X_d$

で表わされ、

前記XはCrおよびAg, Ba, Co, Ni, Pt, Si, Sr, Au, Cd, Cu, Li, Mo, Mn, Zn, Al, Fe, Pb, Na, Cs, Ga, Pd, Bi, Sn, Ti, V, In, W, Znおよびランタノイド元素の少なくとも一つの元素を表わし、それぞれ前記a, b, cおよびdが、それぞれ $0.02 \leq a \leq 0.19$, $0.04 \leq b \leq 0.4$, $0.5 \leq c \leq 0.75$, $0.03 \leq d \leq 0.3$ の範囲にあり、

当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、当該薄膜の平均組成を、元素単体または化合物組成の低融点成分Lと元素単体または化合物組成の高融点成分Hにより

$L_j H_k$

の式で表した時、 $20 \leq k / (j + k) \leq 40$ である組成を基準組成とし、上記情報記録用薄膜を構成する各元素の膜中での含有量は前記式で決まる値±10原子%の範囲内にある情報記録用薄膜を有することを特徴とする情報記録媒体。

【請求項4】 基板上に直接または保護層を介して形成された、エネルギーービームの照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用薄膜を有する情報記録媒体において、前記情報記録用薄膜の膜厚方向の平均組成が、一般式

$(G_e a S_b b T_e c)_{1-d} X_d$

で表わされ、前記XはCrおよびAg, Ba, Co, Ni, Pt, Si, Sr, Au, Cd, Cu, Li, Mo, Mn, Zn, Al, Fe, Pb, Na, Cs, Ga, Pd, Bi, Sn, Ti, V, In, W, Znおよ

びランタノイド元素の少なくとも一つの元素を表わし、前記a, b, cおよびdが、それぞれ $0.25 \leq a \leq 0.65$, $0 \leq b \leq 0.2$, $0.35 \leq c \leq 0.75$, $0.03 \leq d \leq 0.3$ の範囲にあり、

当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、当該薄膜の平均組成を、元素単体または化合物組成の低融点成分Lと元素単体または化合物組成の高融点成分Hにより

$L_j H_k$

の式で表した時、 $20 \leq k / (j + k) \leq 40$ である組成を基準組成とし、上記情報記録用薄膜を構成する各元素の膜中での含有量は前記式で決まる値±10原子%の範囲内にある情報記録用薄膜を有することを特徴とする情報記録媒体。

【請求項5】 前記BおよびXの少なくとも一方が膜厚方向において濃度勾配を有することを特徴とする請求項1乃至4のいずれかに記載の情報記録媒体。

【請求項6】 当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、その析出物が前記BおよびXの少なくとも一方で表わされる元素を含んでいる請求項1乃至5のいずれかに記載の情報記録媒体。

【請求項7】 当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、高融点成分の構成元素の原子数の和が、当該薄膜の構成元素の全原子数の和に対して10~50%の範囲にある請求項1乃至4のいずれかに記載の情報記録媒体。

【請求項8】 基板上に直接または保護層を介して形成された、エネルギーービームの照射を受けて生じる原子配列変化によって情報を記録または再生する情報記録用薄膜を記録層または超解像読み出し用のマスク層として備え、かつ反射層の膜厚が、150nm以上300nm以下である特徴を持つ情報記録媒体。

【請求項9】 基板上に直接または保護層を介して形成された、エネルギーービームの照射を受けて生じる原子配列変化によって情報を記録または再生する情報記録用薄膜を記録層または超解像読み出し用のマスク層として備え、かつ光入射側にSiO₂層と記録膜側にZnS-SiO₂層の2層構造の保護層を備えた情報記録媒体。

【請求項10】 基板上に直接もしくは保護層を介して形成され読み出し用ビームの照射を受けて超解像効果を生ずる超解像読み出し用薄膜を有する情報記録媒体であつて、少なくとも相変化成分及び該相変化成分より融点が高い高融点成分を含み、高融点成分は析出しており、前記超解像読み出し用薄膜の平均組成が一般式

$D_e E_f F_g$

で表され、前記DはSn, Pb, Bi, Zn, Ga, Inから選ばれた少なくとも1つの元素、前記EはAs, B, C, N, O, S, Se, Si, Te, Ag, Al, Au, Ba, Be, Ca, Cd, Co, Cr, Cs, C

u, Fe, Ge, Hf, Hg, Ir, K, Li, Mg, Mn, Mo, Na, Nb, Ni, Os, Pd, Pt, Rb, Re, Rh, Ru, Sb, Sc, Sr, Ta, Ti, V, W, Y, Zrより成る群より選ばれた少なくとも1つの元素、前記Fは前記D及び前記Eで表される以外の少なくとも1つの元素を表し、前記e, f及びgの単位はいずれも原子パーセントで、それぞれ $3 \leq e \leq 95$ 、 $5 \leq f \leq 50$ 、 $0 \leq g \leq 20$ の範囲にあり、平均組成を、元素単体または化合物組成の低融点成分Lと元素単体または化合物組成の高融点成分Hにより $L_j H_k$

の式で表した時、 $20 \leq k / (j + k) \leq 40$ である組成を基準組成とし、各元素の膜中での含有量は前記式で決まる値±10原子%の範囲内にある超解像読み出し用薄膜を有することを特徴とする情報記録媒体。

【請求項11】 請求項10に記載された超解像読み出し用薄膜を備えた情報記録媒体にレーザ光を照射して反射光を検出する光ヘッドとを備える超解像読み出し用装置において、超解像読み出し時の反射光の強度分布の乱れを検出する手段と、上記乱れの大きさに応じてレーザパワーを調節する手段を有することを特徴とする超解像読み出し用装置。

【請求項12】 基板上に直接または保護層を介して形成された、エネルギービームの照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用媒体の製造方法であって、基板上に保護層、記録膜または超解像読みだし膜、中間層、反射層を形成する工程と、これに別の基板または同様にして前記各層を形成した別の基板を貼り合わせる工程と前記媒体にエネルギービームを照射して前記薄膜中に高融点成分を生成または成長させる工程とを備えてなることを特徴とする情報記録用媒体の製造方法。

【請求項13】 基板上に直接または保護層を介して形成された、エネルギービームの照射を受けて生じる原子配列変化によって情報を記録・再生する情報記録用媒体の製造方法であって、基板上に保護層を形成する工程と高融点成分の材料あるいは高融点成分の組成に近い組成を持つ材料を被着させて島状の種結晶を形成する工程と、前記種結晶の上に前記高融点成分と前記残成分とを含む材料を被着させ、前記高融点成分を選択的に前記種結晶上に成長させると共に、それら種結晶の間を埋めるように前記残成分を成長させる工程と中間層、反射層を形成する工程と、これに別の基板または同様にして前記各層を形成した別の基板を貼り合わせる工程と備えてなることを特徴とする情報記録用媒体の製造方法。

【請求項14】 基板上に直接または保護層を介して形成された、エネルギービームの照射を受けて生じる原子配列変化によって情報を記録または再生する情報記録用媒

体の製造方法であって、基板上に保護層を形成する工程と、相変化成分と高融点成分より成る膜の形成を行ないつつ高融点成分の含有量を膜厚方向に変化させる工程と、中間層、反射層を形成する工程と、これに別の基板または同様にして前記各層を形成した別の基板を貼り合わせる工程を備えてることを特徴とする情報記録用媒体の製造方法。

【手続補正3】

【補正対象書類名】明細書

【補正対象項目名】0026

【補正方法】変更

【補正内容】

【0026】 (12) 前記2, 5および6のいずれかに記載の情報記録用薄膜において、当該薄膜の残成分より相対的に融点が高い高融点成分からなる析出物を含んでおり、当該薄膜の平均組成を元素単体または化合物組成の低融点成分Lと元素単体または化合物組成の高融点成分Hにより

$L_j H_k$ (6)

の式で表した時、 $20 \leq k / (j + k) \leq 40$ (7)

である組成を基準組成とし、各元素の膜中での含有量は前記式で決まる値±10原子%の範囲内にあることを特徴とする。

【手続補正4】

【補正対象書類名】明細書

【補正対象項目名】0052

【補正方法】変更

【補正内容】

【0052】 (38) 前記26または32のいずれかに記載の情報記録用薄膜において、平均組成を元素単体または化合物組成の低融点成分Lと元素単体または化合物組成の高融点成分Hにより

$L_j H_k$ (6)

の式で表した時、 $20 \leq k / (j + k) \leq 40$ (7)

である組成を基準組成とし、各元素の膜中での含有量は前記式で決まる値±10原子%の範囲内にあることを特徴とする。

【手続補正5】

【補正対象書類名】明細書

【補正対象項目名】0123

【補正方法】変更

【補正内容】

【0123】 高融点成分の屈折率 (n, k) の好ましい範囲は、相変化成分がGe-Sb-Te系の場合は、 $5.0 \leq n \leq 6.2$ 、 $1.1 \leq k' \leq 6.1$ であり、相変化成分がIn-Sb-Te系の場合は、 $1.5 \leq n \leq 1.8$ 、 $0.6 \leq k' \leq 3.6$ である。